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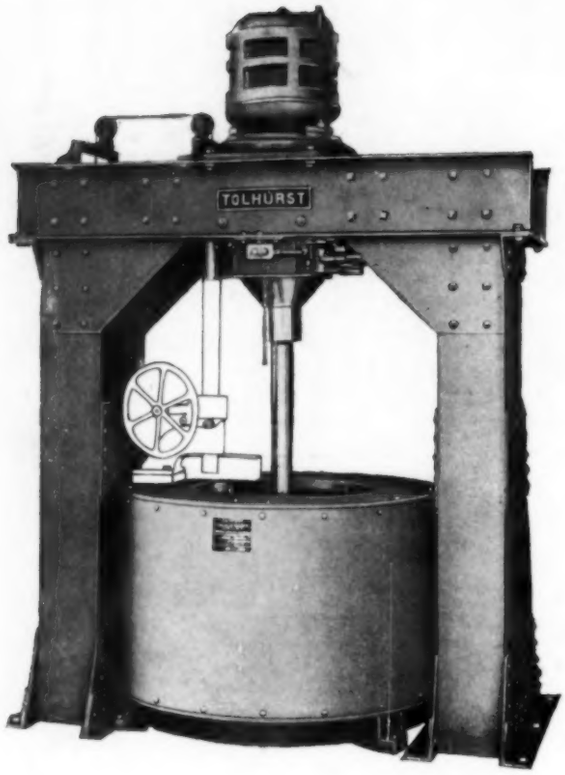

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MAY, 1929

S. D. KIRKPATRICK, *Editor*

An Opportunity— Not a Threat

ANNOUNCEMENT of the American I. G. Chemical Corporation marked a significant but long-expected move on the part of the German trust. It is not surprising that in some quarters it should have stirred up smoldering war hatreds and loosed again the bogey of Teutonic domination. Naturally, there also has been speculation as to the effect on American technology and industry, but a factual rather than an emotional analysis of the situation reveals little ground for hysterical opposition or ominous forebodings. On the contrary, the entry of the I. G. brings to chemical industry certain new interests, American as well as German, that will provide a still greater opportunity for technical and commercial progress.

AMERICAN industrialists of the caliber of Teagle of the Standard Oil Company of New Jersey and Mitchell of the National City Company, have not lent their support to any plan to sell out American chemical industry. These men have seen our own industries grow beyond national boundaries, but they also have observed the fallacy of foreign management, technical personnel and equipment in American enterprise. In this instance, new capital to the extent of $60,000,000 will back a combination of German and American technology in building in this country a diversified American chemical industry.

THE American I. G. Chemical Corporation is merely the holding company in this country for the firms that will carry forward the development. The General Aniline Works and the Agfa-Ansco Corporation account for a relatively small proportion of its prospective holdings. It is expected that another corporation will shortly carry out the apparently well-laid plans of the I. G. to transfer a part of its nitrogen and synthetic fertilizer production to the United States. Already there is active consideration of plant location in several sections of the country, and German and American engineering delegations have begun the exchange of technical information.

WHAT is likely to be the significance of this development in relation to American industry and technology? Obviously, it will mean increased competition, but from a concern subject to the same laws and economic conditions that control all American operations. Doubtless it will encourage additional mergers, in order to bring about better alignment of competitive forces. In technology there also will be stimulating competition, but with it the opportunity to demonstrate the comparative soundness of American and German methods and engineering equipment.

CHEM. & MET. is not among those who would decry the American I. G. on the questionable ground of patriotism or in helpless fear of German technical supremacy. We have no quarrel with a program that means the building of an American industry with American money. The greatest return on that capital will come through working with rather than against the best interest of the American chemical industry as a whole.

Twelfth Exposition of Chemical Industries

THERE is no adequate substitute for the Chemical Exposition. Those of our readers who did not spend the week of May 6, or at least part of it, in New York City are the losers. No written report can give the first-hand impressions, contacts and experience of the 18,000 who visited the booths and attended the concurrent activities. The experiment of the biennial spring meeting apparently proved a satisfying success as indicated by the vote of the exhibitors' committee to hold the next exposition during the week of May 4, 1931. The season reacted less favorably upon attendance at the student courses, perhaps indicating the necessity for developing closer relations with the schools in which chemical engineering is taught. On the whole, however, the Twelfth Exposition of Chemical Industries demonstrated anew the important part the Exposition plays as an institution in developing and promoting the progress of chemical engineering in industry.

Chemical Industry and the New Tariff

READJUSTMENT rather than revision appears to have been the guiding motive of the Ways and Means Committee in its treatment of the chemical schedule of the Tariff Act of 1922. Only those items which have been adversely affected by changing conditions in the induustry during the past seven years have had the committee's attention. Of several hundred rates in the schedule, those for 39 commodities were changed, of which 33 were increases and 6 were decreases. With one or two notable exceptions, which may yet be remedied in the Senate, H. R. 2667 is eminently fair in the treatment accorded chemical industry.

Accompanying the chemical schedule was the report of the subcommittee on chemicals—in effect a concise economic history of the advances in chemical industry in recent years. It is a most able document, except for its repeated and oftentimes far-fetched reference to the relation between chemical industry and agriculture. A certain amount of this political "window-dressing" was to be expected, but it is perhaps carrying farm relief too far to boost the duty on inedible blackstrap molasses by more than 1,200 per cent—from one-sixth to 2.19 cents per gallon. Whether the purpose was to protect the cane-sugar producer or to pave the way for a greater use of grain in the manufacture of industrial alcohol is not indicated. In either case this chemical industry would be forced to carry the burden along with that of government regulation of output, special taxes, and increasing competition from other materials.. Agriculture influences are also to be seen in the 56 cents per bushel impost on linseed (where fortunately a compensating duty is placed on the oil) and in the increased rates on soy-bean, palm kernel and sesame oils. Ammonium sulphate is the only fertilizer material to remain on the dutiable list despite the manufacturers' urgent plea for protection against foreign mixtures and compounds.

Important changes are proposed in the administrative provisions of the bill. One departure grants to customs appraisers the power to apply American valuation in assessing duties when the officials are unable to ascertain foreign values. Where disputes arise over valuations, final decision rests with the Secretary of the Treasury rather than with the customs courts. Likewise the provisions for the so-called flexible tariff and those defining the functions and organization of the Tariff Commission have been modified to make them workable and more effective from the standpoint of tariff administration.

Patient Capital and Vision in Research

BENEFITS of research as a dividend-paying proposition have been extolled many times and careful capital now looks at this end of any business before making an investment. It is somewhat rare, however, to find capital possessed of years of patience, in addition to insight and vision into the future of research, particularly in a highly competitive and unprotected industry. When a chemical engineer has helped to engender these attributes in capital he has done a remarkably good service for his profession and for the industry.

The most outstanding example of such an accomplishment is the work of Dr. John E. Teeple and the American Potash & Chemical Corporation, whose plant is described by Dr. Manning in this issue. Potash and borax have long been virtual monopolies as far as the American markets are concerned. Germany so far controlled the potash market that it was suicidal for any manufacturer to attempt to enter this market except during extraordinary times. Following war-time conditions most of the American potash manufacturers quietly ceased operations forever.

Possessed of a vision which came from knowledge and sound judgment, Dr. Teeple planned and organized the research and operations of the old American Trona Corporation with such skill that after a short shutdown the plant began active competition with German-made potash. After further improvement of process and enlargement of plant the production of potash began to supply a definite part of the American market despite the fact that the plant is in a Western desert and thus suffers from the disadvantage of adverse freight rates. Then began the production of borax as a byproduct.

Entering this field, which was practically monopolized by another company, the production of pure borax was carried to the point where the price of borax had been cut to less than half that of the past few years. The technology of all borax production was revolutionized completely by sound chemical engineering methods developed through research. The plant now operates continuously as the largest producer of refined borax in the world and as one of the largest potash plants.

Not satisfied with this work, research on production continues and, in addition, studies of new uses for borax are in progress. An unselfish service to industry consists in advising users of borax who are not necessarily customers, and in giving freely, the results of costly investigation. Meanwhile production research insures that the price of borax will remain low and may go even lower. With such assurance the American chemical industry will make good use of this chemical at its new low price. The glass industry has awakened to its opportunity and others are following. Borax will replace soda ash in many industries and management need have no feeling of doubt as to quality and availability.

Thus have patient capital and vision, backed by sound chemical engineering, again served industry.

The Southern March of Chemical Progress

FOR two generations after the Civil War the Southern States were neglected by the manufacturer of chemicals and the developer of chemical engineering processes. One or two pioneers had established outposts in Virginia, West Virginia, Alabama and Tennessee even before the World War, but real chemical progress dates from the last decade. Today a thriving industrialism throughout the entire Southeast has created a large and diversified market for chemicals and has convincingly demonstrated the opportunity for industries that can capitalize on the many natural advantages of the area. Competent, impartial observers agree that during the next ten years the South probably is destined for greater chemical progress than any other section of the country.

A remarkable record has already been made. It is only necessary to recall that the two new air-nitrogen plants are at Charleston, W. Va., and Hopewell, Va., and that, in all probability, the nitrogen subsidiary of the American I. G. will be established in Southern territory. Every important rayon development in the past few years has been south of the Mason and Dixon Line. New plants or the extension of existing capacity are under construction at Roanoke, Richmond and Waynesboro, Va., Asheville, N. C., Rome, Ga., and Nashville and Elizabethton, Tenn. The most recent move is on the part of the rubber industry, in which a decentralizing trend has led to the establishment of important branch plants at Gadsden, Alabama, and Atlanta, Georgia.

Southern chemical industries that have grown most rapidly are those that have utilized the raw materials available in the area. The coal, oil and gas of the Great Kanawha Valley of West Virginia, the brines at Saltville, Va., the phosphate rock in Tennessee and Florida and the coal, iron and limestone of Birmingham are some of the mineral resources that have been profitably exploited. Timber is another Southern asset which chemical engineering is making more and more valuable. This is true in the modern wood preservation plants such as that of Taylor-Colquitt at Spartanburg, S. C., which is described in this issue. Chemical engineering finds equally important application in hardwood distillation at Nashville and Kingsport, Tenn., in the pulp and paper industry at Canton, N. C., Bogalusa, La., and elsewhere, and, finally, in the naval stores developments in Georgia, Florida and Mississippi. Here a decadent industry has been vitalized by the application of a technology which has opened up entirely new possibilities for its future growth.

In the industrial fields yet to be developed, ceramics appears to be the most promising, for excellent deposits of clay, feldspar and other raw materials are available in Georgia and the Carolinas. There is likewise an important market for textile chemicals in the bleacheries and the dyeing and finishing establishments of the Greenville, S. C., area. The largest single consumer of synthetic indigo in the world is located at Greensboro, N. C., while Charlotte, in the same state, has become an important distributing center for chemicals, dyestuffs, and allied products.

These present and potential developments are cited here because they represent a definite trend that must be carefully studied and logically controlled. For the good of the South and for the good of the chemical engineering industries as a whole the pendulum of neglected opportunity must not be permitted to swing to the other extreme. The movement must not become a chemical stampede into the South. Rather we must make sure of our facts through investigation and engineering study of plant location. A sane, conservative development will prove more profitable than any frenzied rush of competitive industries.

Business Looks to Science and Research

"THE task of identifying and appraising the growing responsibilities of business and business men" was stated by the president of the Chamber of Commerce of the United States in his address at the recent annual meeting as the main objective of this annual gathering. No higher purpose or more commendable effort could have been cited. It is a matter for general satisfaction, therefore, that there can be reported so successful an accomplishment of its purpose by this national forum of organized business.

President Butterworth, in the address referred to, stated another generalization, which will be welcomed particularly in the chemical engineering industries, when he said: "Tradition is having a hard time . . . . science and business teamed together are making commonplaces of the miraculous." Executives in our own industry have keenly appreciated these facts for a long time; boards of directors have been gradually acquiring an understanding of them. But it is even more gratifying that bankers and business men generally, most of whom are not in day-to-day contact with technically controlled industry, are sensing the fundamental importance of scientific and engineering research and development.

This impact of science on business was effectively portrayed from another angle by Charles F. Kettering. He characterized organized research as a "department of systematic change-making in industry." While instinct urges a man to "stay put" his intelligence tells him that nothing is as constant as change. "The only product of research is change. The research department must keep the customer reasonably dissatisfied with what he has. It must study the economics of change, the necessity of change, the direction of change and the rate of change. The modern business must budget for constant change and progress." Research might, therefore, be very appropriately called "industrial budgeting." It likewise serves as the procurement department for new ideas.

It is not enough, however, that through such brilliant interpreters as Kettering the business man should come to understand the achievements and functions of the scientist and engineer. It is just as essential that the engineer sense the broader public-service spirit of business leaders. Our specialized scientific, engineering and trade organizations should take notice of the far-seeing ethical principles which are so clearly recognized and advocated by the national Chamber of Commerce. The specialized groups diligently study the generalizations of the chamber and undertake to apply them promptly and whole-heartedly in the specialized tasks to which these groups address themselves. The national chamber has set for the rest of organized business an attitude in public relations that should be cordially commended and sincerely imitated.

CAPITAL + VISION +

Searles Lake and the Plant of the American Potash & Chemical Corporation

By Paul D. V. Manning

Assistant Editor
Chemical & Metallurgical Engineering
San Francisco, Calif.

DEVELOPMENT and establishment of what has now become one of America's major chemical industries is an outcome of the early pioneering of John W. Searles, who first began the exploitation of the saline deposits of Searles Lake, Calif., around 1860.

The "lake" has an approximate circular area of 12 sq. miles with an average depth of 70 ft. The whole depth of the lake is made up of salt crystals, the top 15 ft. being sodium chloride. Below this is a mixture of crystals and still further down is found a crystal deposit predominating in trona.

The interstices of the crystals hold the brine, the level varying from 4 in. below to 6 in. above the surface. The crystals occupy about 70 per cent of the volume and are chiefly borax, trona, and the sulphates, chlorides and carbonates of potassium and sodium. The brine, being saturated in these various components, presents an unusually complex multi-component phase rule system. The deposit is wholly unlike the German potash deposits for the reason that the latter resulted from sea water evaporation and not the evaporation of solutions from the leaching of volcanic mountains.

The many years of research and experimental work by the staff of the American Potash & Chemical Corporation have been chronicled elsewhere. (A. C. S. Monograph No. 49. J. E. Teeple.) With a complete knowledge of the system involved worked out in the research laboratory, engineers developed a plant which had a daily production of 85 tons of potassium chloride and 45 tons of borax. The major part of this work was consummated under the general direction of Dr. John Teeple.

During 1926 the present management undertook the tremendous feat of enlarging and completely rebuilding the plant without stopping production. Present 24-hr. production is over 240 tons of potash, 130 tons of borax, 15 tons of technical, and 10 tons of U. S. P., boric acid.

The raw saline material consists of brine pumped from the crystal bed of the lake. Analysis of this brine shows the following major constituents:

Constitutents	Per Cent, by Weight
Sodium Chloride, NaCl	16.35
Sodium Sulphate, Na_2SO_4	6.96
Potassium Chloride, KCl	4.75
Sodium Tetraborate, Dekahydrate	2.86
Sodium Carbonate	4.74
Other chemicals	0.47
Water	63.87
Total solids	36.13 per cent.

Other chemicals include phosphates and salts of arsenic, lithium, antimony (0.0006 per cent), etc.

The brine is pumped from ten wells in the crystal bed, each penetrating the crystal bed to a depth of 65 ft. below the surface, at which point the crystals are richest in glaserite. The temperature of the brine at the depth noted is 72 deg. F. and neither the temperature nor composition varies during the year. This constant-quality raw material makes possible the delicate control and careful balancing of the recovery process used.

Brine from the wells is drawn through 6-in. pipes to a Cameron centrifugal pump operated by a 100-hp. 2300-volt motor. The brine leaves this pump and passes through a 10-in. line to the plant. This line is insulated to prevent changes in outside temperature affecting the brine. There are 20,000 ft. of pipe line between the pump house, located on the crystal bed, and the plant. Three booster pumps are provided along the line. Under normal operation the flow of 1,000 g.p.m. is maintained with the well pump and one booster pump operating under a static head of 80 ft. The installation was designed to furnish 1,500 g.p.m. The brine is stored at the plant in two 500,000-gal. storage tanks. This is sufficient to carry the plant for 16 to 18 hours.

Treating the brine to produce a pure potash and borax utilizes a process of fractional crystallization wherein, by concentrating, heating and cooling at appropriate stages, the several products are obtained. It may be roughly divided into the following five basic steps:

1. Partial evaporation of the brine. This is accomplished in large triple-effect evaporators. It is carried to the point where the boiling and concentrated brine is saturated with potassium chloride. During this process a mixture of sodium chloride and burkeite separates out and is removed from the solution. Burkeite is a double salt having the formula $Na_2CO_3.2Na_2SO_4$. Because of the fact that during the evaporation the liquor is always in the burkeite field and at the same time it is always saturated with sodium chloride, these two substances will constantly precipitate as water is removed isothermally. In reality, under conditions of operation a mixed crystal of sodium carbonate and sulphate along with sodium chloride crystals are obtained. These salts are removed and washed to the lake. The total amount removed averages about 2,000 tons of wet salts per day.

N + RESEARCH =

An American POTASH Industry

2. Cooling of the hot, partially concentrated liquor to precipitate some of its potash and removal of the latter. This is accomplished by flash coolers and centrifuging, the latter step while the liquor is supersaturated with borax.
3. Drying of the potash in rotary drum furnace gas driers.
4. Further cooling of first mother liquor with the crystalliizing and removal of the borax. This is done with Baudelot and double-tube coolers and seeding of the supersaturated solution in vertical crystalizers. The suspended borax is removed by centrifugals.
5. Refining of the borax. This is accomplished by hot solution of the crude borax, cooling and crystallizing in evaporative coolers and centrifuging. The borax is then dried in rotary-drum hot-air driers, after which is is screened.

Production results from the operation of two parallel sets of apparatus of approximately the same size. Space does not permit a detailed description of all phases of the process and apparatus. It will be summarily described and later articles will cover in more detail several interesting parts of the process.

Steam is generated at a pressure of 160-lb. gage in fourteen 500-hp. Babcock & Wilcox boilers. Electrical energy is generated by three General Electric turbo-generators. The turbines used are of the non-condensing type. The maximum demand of electrical energy is about 2,900 kw.

Three Corliss driven De La Vergne ammonia compressors furnish 200 tons of refrigeration each per day, this being used in the borax crystallizing. Condensers for the refrigerating plant are located adjacent to the cooling towers and the superheat is first removed from the ammonia gas before it goes to the final condensers.

The cooling tower installation handles 25,000 g.p.m. for the ammonia condensers, evaporator condensers, evaporative coolers, etc. Due to high summer temperatures, the water from the towers at times reaches 90 to 95 deg. F.

Lake brine from the storage tanks (specific gravity 1.3) is used for direct cooling purposes, passing to a sump. This does not change the brine. From the sump it is pumped to the evaporator feed tank. Part of it is used for washing filters. In the feed tank it mixes continuously with the end liquor from the process.

This mixed liquor then feeds into the third effect of the evaporator. The flow of liquor is countercurrent to the flow of steam, the liquor flowing from the third effect to the second and then to the first. Exhaust steam at 28 lb. gage pressure from the prime movers is used to heat the liquor in the heaters attached to the first effect. Steam from the second effect is used to heat the third while the steam from the third is condensed by a barometric condenser operating countercurrently (Weiss type). The condenser body is a cylinder 20 ft. long, 8 ft. in diameter, with an added cone bottom. The water flow is 8,000 to 10,000 g.p.m. Non-condensible vapors are removed from the barometric head by Wheeler Rado-jet two-stage pumps. The barometer at this elevation is normally about 28¼ in. and vacuum obtained is about 1½ to 1¾ in. absolute.

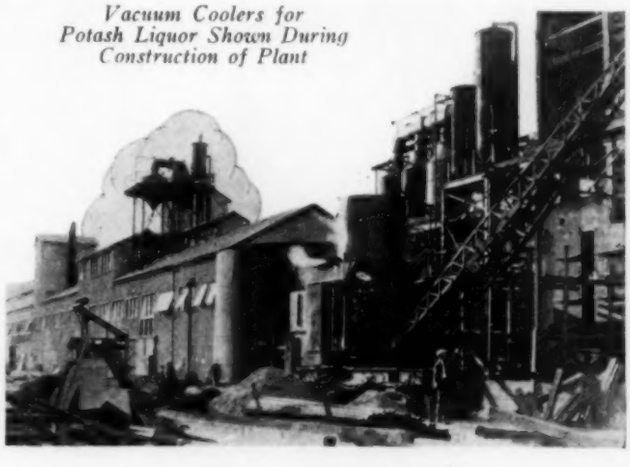
The evaporators formerly were of the internally heated type. At the time of rebuilding, the calandrias were removed and new external heaters substituted. The bodies of the effects are 22 ft. in diameter and 40 ft. high, shaped roughly as shown in Fig. 1, which gives diagrammatically the operating cycle. In operation each effect contains around 30,000 to 40,000 gal. of liquor which is held at such a level that the static head prevents the liquor flashing in heater lines.

Heating for each evaporator is accomplished by four four-pass heaters arranged in parallel with a pump for each heater. A manifold at the base of the evaporator is fitted with four large Merco-Nordstrom worm-gear operated cocks. Each heater is connected through a pump to the manifold. The pumps used are Cameron wide-port, closed-runner type, each operated by a 25-hp. motor.

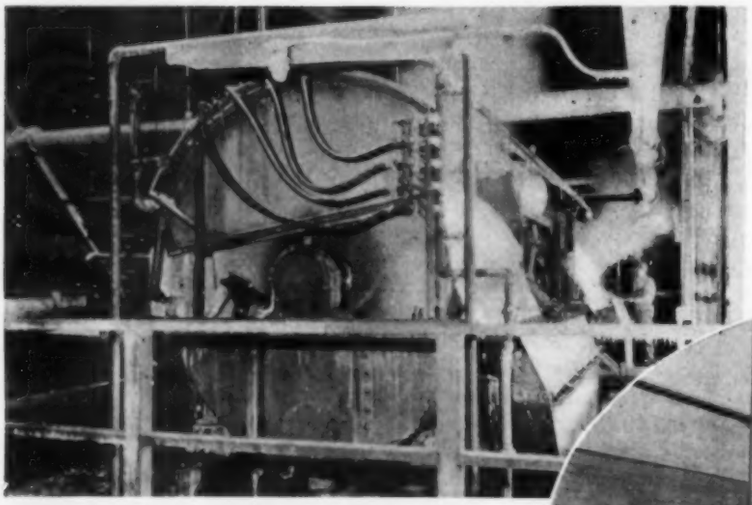
Heaters are rectangular in cross-section, the passes being vertically disposed and 18 ft. long. The tubes are 2½ in. outer diameter, made of charcoal iron, there being 78 tubes per pass. Steam and liquor flows are countercurrent, the liquor entering from the bottom. Velocity of liquor through the tubes is 4 ft. per second. The liquor leaving each heater passes through a separate line, through a Merco-Nordstrom cock and enters the evaporator at a point slightly below the liquid level.

Entrance of the liquid is effected at four equidistant points, around the circular belt of each evaporator, one for each heater. Under normal operation, all heaters operate in parallel at the same time, one at a time being shut down for washing at intervals of 18 to 30 hr. Steam enters each battery of heaters through a large manifold at the top, the supply pipe being located at the middle of the manifold. Entrained liquor is removed from

Vacuum Coolers for Potash Liquor Shown During Construction of Plant

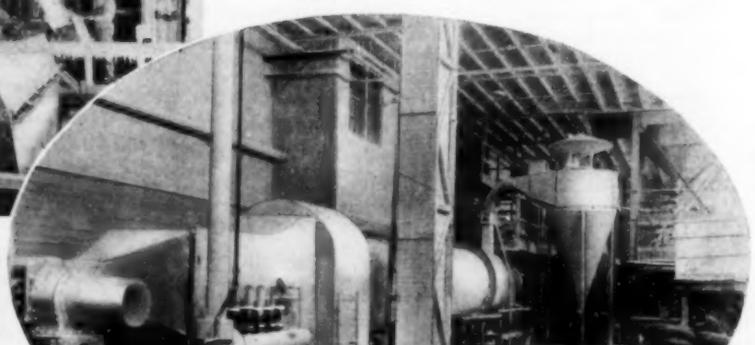


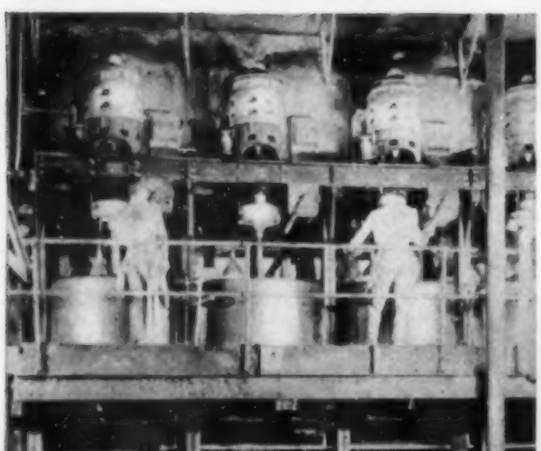
Plant of American Potash & Chemical Corporation at Searles Lake, Calif.

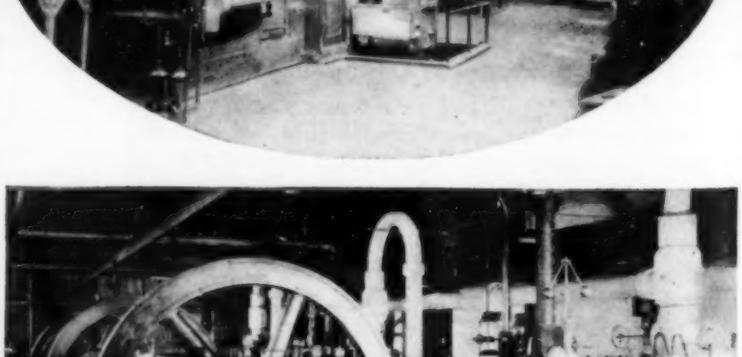


Oliver Filters Are Used for Filtering the Waste Salts

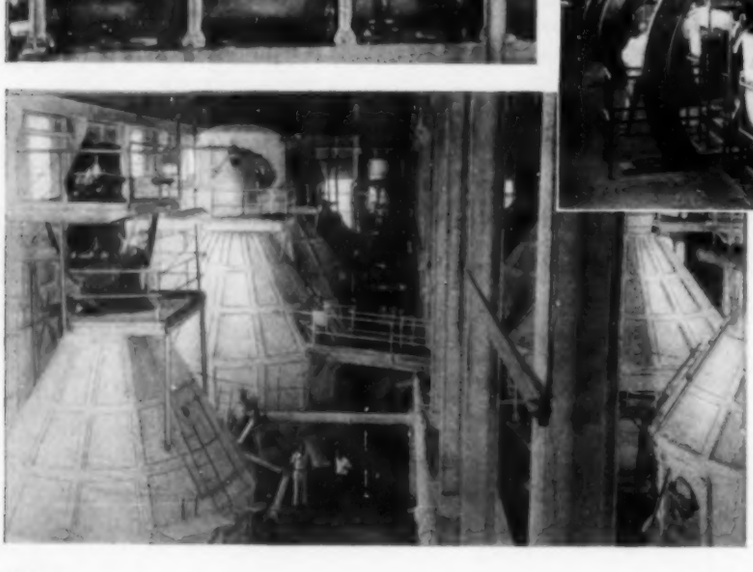
Boric Acid Is Dried by Air Heated by Steam in a Double Rotary Drum Drier







Three Corliss Driven De La Vergne Ammonia Compressors for Borax Crystallizing



Battery of Centrifugals for Removing Potash Crystals (Next to Last View at Left)

Two Parallel Sets of Large Triple-Effect Evaporators

the vapor from each effect by catchalls of the centrifugal type.

The thermal operating data are summarized in the following table:

Effect No.	1	2	3
Steam pressure to heaters.....	25 lb. gage	Atm.	20 -in. vacuum
Temp. heater condensate.....	265 deg. F.	210 deg. F.	.....
Vapor chamber pressure.....	Atm.	20-in. vacuum	26½-in. vacuum

The Searles Lake brine foams very badly when heated and it would be practically impossible to operate an evaporating system without overcoming this tendency. It is overcome through the continuous addition of a small quantity of fatty acid. Capric acid is the best substance so far found. As its cost is prohibitive, cocoanut oil containing about 50 per cent lauric acid is used.

The brine entering the evaporator system being saturated with sodium chloride and in the burkeite field, the constant removal of water precipitates salt and mixed sodium carbonate and sulphate crystals. To keep down these suspended solids, liquor from the bottom of the evaporating chamber is continually withdrawn at a rate such that if the liquor all stayed in the evaporator it would be changed twice each hour. The circulation amounts to 70,000 g.p.h. This liquor passes to the elutriator where the salts are counter currently washed with the liquor from the other effects. Part of the liquor then returns to the same effect; the remainder advances to the next effect. The salts are further washed with raw brine and filtered through three 5x8 Oliver filters. The cake then passes via the sewer back to the lake. These salt-trap salts when filtered amount to about 1,600 tons per day and have the following approximate composition: NaCl, 60 per cent; burkeite, 30 per cent, and water, 10 per cent.

The liquor leaving the first effect passes through the elutriator. Part of it returns while the remainder passes tangentially into a clarifier. The clarifier is simply an old 16-ft. evaporator shell. The clarified liquor is slightly diluted with condensate from the third-effect heaters and passes to a round, 40x24-ft. storage tank. The clarifier sludge contains about 30 per cent solids and passes to two 5x8-ft. Oliver filters. The cake, of which there is 400 tons per day, has the following approximate composition: Na_2CO_3, 40 per cent; Na_2SO_4, 45 per cent; NaCl, 5 per cent, and water 10 per cent.

The filters are arranged to operate interchangeably and are blown with steam.

The elutriator, like most of the other major pieces of apparatus, was devised and designed by the plant engineers. It consists of a 12-ft. vertical airtight cylinder 24 ft. high with an added 12-ft. cone. Within this cylinder are three funnel-shaped cones, spaced equally vertically, the upper and larger ends being integral with the outer cylinder wall. The lower short neck of each cone is barely inside of the lower cone and is constricted below this point, as shown in Fig. 2.

Liquor from the first effect enters the top of the upper cone, passing out on the opposite side. Its salts fall through the neck of the cone to the next cone. Liquor from the second effect enters at the top of the second cone. It drops its salts and washes the descending salt from the upper cone, passing out at the top of the cylinder just below the edge of the upper cone. Liquor from the third effect enters the top of the third cone and leaves the cylinder just under the edge of the second cone, washing the salts from the upper cones.

The flow through each cone is about 1,000 g.p.m. Of this from 150 to 300 g.p.m. passes to the next effect,

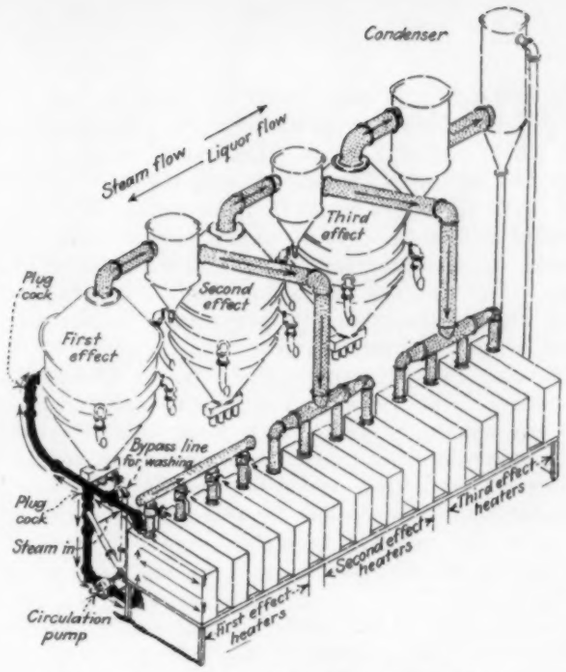


Fig. 1—Evaporator Flow Sheet, Steam End; Liquor Manifolds Are Connected to Heaters and to Elutriators

the remainder being returned to the effect whence it came. The flow from the first effect to the clarifier is about 150 g.p.m. The specific gravity of the liquor is about 1.38.

Due to the increase in solubility of potash and borax with the temperature increase, and to the fact that the other salts have inverse solubility curves in the brine, the evaporation process drops out part of the sulphate, carbonates and chloride of sodium and brings the hot liquor to the point of saturation in potassium chloride but not borax. Cooling by evaporation or further evaporation of this liquor at this point will throw out a mixture of all salts except borax. Consequently the liquor is diluted slightly with sufficient water from the condensate from the third effect heater to prevent the precipitation of sulphates, carbonates and chlorides of sodium when the same amount of water is removed in cooling by evaporation. This water is added by means of a small carefully regulated pump, discharging into the liquor line which carries the hot concentrated liquor from the clarifier to the storage tank.

The hot diluted liquor is pumped to primary vacuum coolers. These coolers operate continuously, vacuum being maintained by barometric condensers and steam jet pumps. Cooling to about 130 deg. F. takes place and at this temperature the borax content is slightly below the saturation point. A second set of coolers brings the liquor very quickly to a temperature of 95 deg. F. From this point on rapidity and smoothness of operation is essential as the liquor is now supersaturated with respect to borax and contains potassium chloride in the solid phase. It is at once centrifuged in a battery of eight 40-in. Cresson-Morris centrifugals. After washing, the cake is discharged with a water content of about 6 per cent and is dried in an American Process drier. The drying is accomplished by passing flue gas from an oil fire mixed with air concurrently with the potash through a rotating drum. The dried product contains 0.2 per cent water. The dried potash is automatically weighed and carried by a long belt conveyor to the warehouse.

The liquor from the potash centrifugal sump next

passes through a tubular heater where it is heated to 140 deg. F. This carries it above the supersaturation point with respect to borax. The heated liquor is then pumped to the top of four carbonating towers in parallel. Each of these towers is 10 ft. in diameter, 20 ft. high and filled with coke. As the liquor trickles down over the coke it encounters an upward flow of boiler-stack gasses. This permits the carbon dioxide in the gas to reduce slightly the alkalinity, preventing the formation of double salts and metaborates.

Following the carbonation, the liquor is diluted with wash water from the borax centrifugals and end liquor from the refining process. It is then pumped through water-cooled Baudelot pipe coolers, where it is cooled to 100 deg. F. It is then cooled to from 72 to 75 deg. F. in double-pipe brine coolers by refrigerated brine. At this point the solution is highly supersaturated with borax and passes into the six crude crystallizers arranged in parallel.

Crystallization of the crude borax is accomplished by appropriate seeding, control of flow and agitation. The slurry is removed by Dorrco pumps passing to the settling tanks supplying the four Cresson-Morris crude borax centrifugals. The mother liquor is mixed with raw brine for evaporator feed. The sludge from the settling tanks is run into the centrifugals after a coarse layer is first run into the basket, 2 in. of settlings being put over the coarse. This prevents loss.

The crude borax is mixed with refined borax end liquor in a sump, pumped through a primary heater to a hot dissolver, which is merely a vertical cone-bottomed tank. The liquor is circulated between dissolver and a secondary tubular heater. Solid borax always is kept in the dissolver, thus permitting an accurate concentration control by regulating the temperature. The liquid usually is heated to 150-160 deg. F. in the dissolver and passes to the filter press tank where a little Supercel is added. The filter presses also are precoated with Supercel. The total used is from 200 to 300 lb. per day. Filtration is accomplished by a set of two Sweetland filter presses in parallel.

The filtered solution then goes to a set of three vacuum crystallizers. These are operated by barometric maintained vacuum. This part of the process is carried out as a batch operation in order to form the uniform and larger crystals which the trade demands. It is exactly controlled by a recording thermometer.

From the crystallizers the batch goes to surge tanks (not settlers) and is then centrifuged and washed in a battery of four Cresson-Morris centrifugals. A part of the liquor is thrown out to "bleed" the system of impurities while the remainder returns to the beginning of the refining process.

The borax is dried by air heated by steam in a double rotary drum drier. The upper drier serves to almost dry the borax, the lower (not heated in summer) to finish the drying. Care is used here to prevent dehydration. The refined product is sized into three grades, the coarse granular (over 90 per cent on 50 mesh) making up 75 per cent of the product; the fine granular (between 50 and 100 mesh) making up 20 per cent, while 5 per cent of powder is obtained. The crystallizers can be operated to give practically any grade, a rapid cooling giving more powder.

Boric acid is manufactured by mixing a small amount of end liquor with fine granular borax, adding concentrated sulphuric acid and cooling to just above the transition point of glaubers salt, which is about 62 deg. F. The boric acid then crystallizes and is centrifuged. It is washed with cold water until it tests 0.2 per cent sulphate. A part of the liquor is returned to the reaction tank; the balance is thrown out to keep down sulphate and is used in the crude borax system where the acidity aids in reducing the alkalinity.

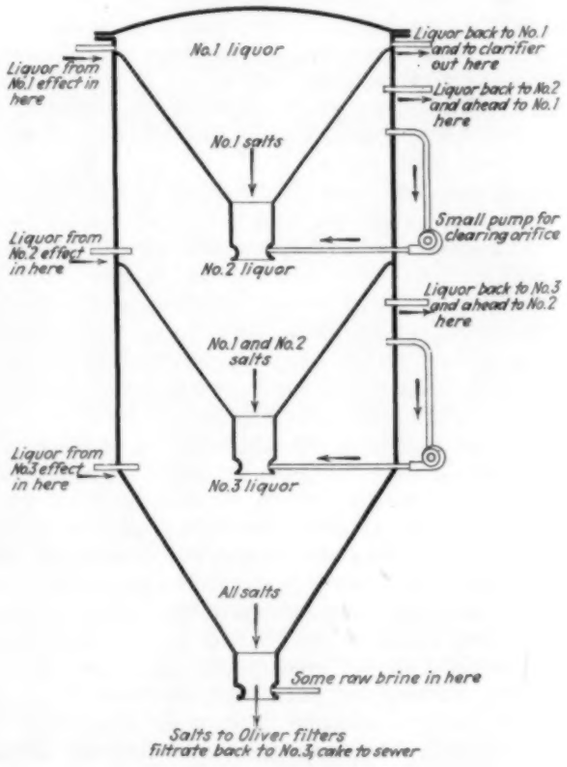
Throughout the plant close control and extremely pure products seem easily attained, the process functions smoothly and the results of careful and systematic research and planning are everywhere evident. The general plant layout is a monument to fine engineering.

Adequate research laboratories operating to solve basic problems in present and future production, not only of products being manufactured but of possible future chemicals, make certain the continuous economical manufacture of high quality standardized products. One is impressed that here is an American industry providing a much needed American source of potash which successfully competes with the foreign article, despite the disadvantages of a Western desert plant location, and which further is providing a new chemical in the low-priced field—borax—as a raw material for the American chemical industry. Two virtual monopolies have thus been broken by this great example of chemical engineering.

Research laboratories and an extensive research program maintained and carried out elsewhere divorce production problems from those related to service to user and investigation of new uses for borax. Such a progressive policy, new to this industry, is an insurance and a valuable aid to the user and the industry as a whole.

The writer is particularly indebted to Frederic Vieweg, R. W. Mumford, W. E. Burke and W. A. Gale for their many kindnesses and their co-operation in the preparation of this paper.

Fig. 2—Elutriator; Liquor Enters at Points Noted From Evaporator Manifolds


No.1 liquor
Liquor back to No.1 and to clarifier out here
Liquor from No.1 effect in here
Liquor back to No.2 and ahead to No.1 here
No.1 salts
Small pump for clearing orifice
Liquor from No.2 effect in here
No.2 liquor
Liquor back to No.3 and ahead to No.2 here
No.1 and No.2 salts
Liquor from No.3 effect in here
No.3 liquor
All salts
Some raw brine in here
Salts to Oliver filters
filtrate back to No.3, cake to sewer

Amination by Ammonolysis—A Unit Chemical Engineering Process

By P. H. Groggins

U. S. Bureau of Chemistry and Soils, Color and Farm Waste Division, Washington, D. C.

OWING to the influence of foreign terminology during the early days of the American dyestuffs industry, considerable differences have arisen in the usage of terms relating to the preparation of compounds containing the NH_2 group. According to E. J. Crane, editor of *Chemical Abstracts*, "a compound containing NH_2 united to a radical of acid character is called an amide, or amido compound. An amine, or amino compound, is one containing NH_2 united to a radical other than an acid radical." The processes of preparing these compounds may be termed amidation and amination, respectively.

A number of methods may be utilized for the preparation of amines, and oftentimes only the changing economic factors or the presence of patent barriers are responsible for the selection of the manufacturing technique for the production of a particular compound. Thus, aniline may be prepared commercially by the ammonolysis of chlorobenzene, the acid or alkaline reduction of nitrobenzene, or the catalytic hydrogenation of nitrobenzene in the vapor phase.

This article will be limited to a discussion of the basic chemical factors underlying ammonolysis. This term may be defined as a method of preparing amines by the treatment of compounds containing halogen atoms, sulphonic acid radicles, hydroxy groups, or a labile nitro group, with ammonia. The following syntheses clearly illustrate the reaction:

Aniline from chlorobenzene

2-Amino-anthraquinone from 2-chloro-anthraquinone

B-naphthylamine from B-naphthol

2-Amino-anthraquinone from anthraquinone-2-sulphonic acid (sodium salt)

6-chloro-3-nitro-o-tolidine from 5,6-dinitro-o-chloro-toluene

(Kenner & Parkin—*J. Chem. Soc.*, 1920)

General Factors Affecting Ammonolysis.—To establish the best conditions for preparing amines by this method it is necessary first to determine the influence of the several factors governing the reaction. These factors are: ammonia ratio, NH_3 concentration, temperature of amination, agitation, effect of catalysts, and influence of common solvents.

Generally speaking, a variation in any one of the above-mentioned conditions of amination will bring about a similar effect regardless of the particular synthesis being performed. Each synthesis, however, has its own optimum conditions, and these must be definitely ascertained in order to obtain a maximum of efficiency.

Effect of Ammonia Ratio.—Aside from economic considerations there are no disadvantages in using a large ratio of aqua ammonia in respect to the material to be treated. Within definite limits an increase in the NH_3 ratio promotes both the yield and the purity of the product obtained. The larger volume of liquid causes the reaction to take place more readily and facilitates the passage of the charge through the pressure system.

The presence of a liberal excess of NH_4OH also exercises a beneficial influence by inhibiting the formation of phenols and imino compounds. These two characteristic impurities always are present in the reaction mass at the close of amination, the quantities being inversely proportional to the quantity and strength of ammoniacal liquor used. Their formation, as occurring in the preparation of aniline from chlorobenzene, may be represented as follows:

(1) Formation of phenolic impurities:

$$C_6H_5Cl + 2NH_4OH \begin{cases} \rightarrow C_6H_5NH_2 + NH_4Cl + 2H_2O \\ \rightarrow C_6H_5OH + NH_4Cl + NH_4OH \end{cases}$$

(2) Formation of imino compounds—diphenylamine by condensation reaction:

(*A*) $C_6H_5NH_2 + C_6H_5Cl \rightarrow C_6H_5—NH—C_6H_5 + NH_4Cl$

(*B*) $C_6H_5NH_2 + C_6H_5NH_2 \cdot HCl \rightarrow C_6H_5—NH—C_6H_5 + NH_3$

The hydrolysis of a small amount of the halide resulting in the formation of phenolic compound is brought about by the action of the hydroxyl ions. The relative proportions of halide thus converted depend entirely on the partial pressures of the NH_3 and H_2O in the reac tion vessel, and it can readily be seen that the formation of phenols will be progressively diminished as the NH_3 concentration is increased.

In the preceding synthesis of aniline, the formation of phenol may be reduced from 5 per cent to 2 per cent by increasing the ratio of NH_3 to halide from 5 to 15. In this instance the phenol is not a serious operating factor, as it may be separated from the bulk of the aniline by treating the reaction mass with caustic soda and then distilling. The aniline is thus removed, while the non-volatile sodium phenate remains. By acidifying the phenolic residue, the free phenol may be recovered from the accompanying diphenylamine.

The formation of imino compounds takes place according to either equation 2*A* or 2*B*. If the former is correct the formation of the condensation impurity is in the nature of a catalytic step in which 1 mole of aniline combines with 1 mole of chlorobenzene in the presence of ammonia. Under such circumstances a small quantity

of diphenylamine will always be present, and considerable experimental evidence can be adduced to show the presence of the imino compound in all stages of the autoclave reaction.

The second equation represents the reaction involved in the preparation of diphenylamine from aniline, wherein a small quantity of aniline salt is used as a catalyst. The conditions optimum for condensation are the reverse of those required for efficient amination. Thus, the former requires a comparatively high temperature and low pressure, this condition being obtained by the intermittent release of the ammonia that is formed. The latter requires a comparatively low temperature and high pressure, and this condition is brought about by maintaining as high a NH_3 concentration as is feasible. In support of this interpretation it is known that the amount of imino compound is progressively decreased by increasing the ammonia ratio and NH_3 concentration, and by preventing overheating.

The use of an excess of ammonia liquor is furthermore desirable, as it provides a volume of liquid in which the halide, sulphonic acid or other reacting material goes into solution at the reaction temperature and pressure.

Effect of Strength of Ammonia.—In the preceding paragraph it was pointed out that beneficial results were obtained in increasing the ratio of NH_4OH to the material to be aminated. It is necessary, however, to emphasize that such benefits accrue only when the NH_3 concentration remains constant so that an actual increase in the ratio of NH_3 to reacting material is obtained with an increase in the volume of ammonia liquor used. It can readily be seen, for example, that in order to obtain a 10 to 1 ratio of NH_3 to halide when 18 per cent and 35 per cent ammonia liquor are available, a larger volume of the weaker solution would necessarily have to be used. Since conversion to amine depends upon NH_3 concentration and not necessarily upon the amount of NH_3 present, it is desirable to reduce as much as possible the OH concentration and the deleterious effects incidental to the use of weak ammonia liquor.

The advantages to be obtained by utilizing a strong ammonia liquor are: (1) a more rapid amination, (2) a more complete conversion of reacting material to amine, (3) the inhibition of phenolic compounds as impurities, (4) the use of lower temperatures, and finally (5) economies in the amount of equipment required, as larger batches of raw material may be treated with the same volume of liquor.

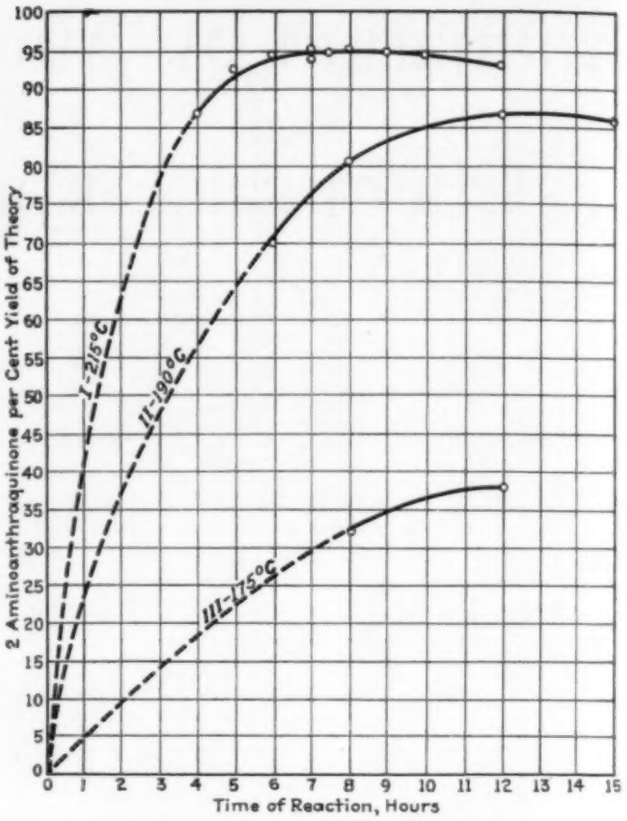
The effects of varying the NH_3 concentration in the preparation of p-nitro-aniline from p-nitro-chlorobenzene are shown in Table I.

In the preparation of 2-amino-anthraquinone the advantages attending the use of a strong NH_4OH are even more pronounced, as in this instance a distinct improvement in the purity, and therefore yield, of the product is obtained. This is largely due to the greater action of the NH_4 ions and the reduced influence of the OH ions, thus inhibiting the formation of hydroxy-anthraquinone.

Table I—Preparation of P-Nitro-Aniline

Strength of Ammonia, Per Cent	Degree of Conversion, Per Cent	Amination Time, Hours
17.76	91.0	10
	93.0	12
21.60	93.0	10
	95.0	12
	98.0	16
	99.0	20
25.48	96.0	10
	98.0	12
	99.0	16
29.40	94.0	8
	98.0	10
	99.0	14
	99.5	16
33.32	96.0	8
	98.0	10
	99.8	12

Temperature 170 deg. C. Ratio NH_3 to halide, 18 to 1



Curves Showing Effect of Temperature in Preparation of 2-Amino-Anthraquinone

Materials: 2-chloro-anthraquinone, 12.125 grams; 29 per cent NH_4OH, ratio 16 to 1; nitrobenzene, 10 grams.

Associated with the factor of NH_3 concentration is the influence of the "freeboard" or free space above the charge in the autoclaves. This is a matter of great importance and must be taken into consideration in carrying out the ammonolysis. When volatile substances are being treated with ammonia the reacting materials will combine more readily in the vapor phase and a free space above the charge is desirable. When, however, chloro-anthraquinone or similar halides are being treated, it is advantageous to fill the autoclave up to its maximum safe capacity. When this is neglected a considerable proportion of the ammonia gas escapes to the free space above the liquor and reduces the actual NH_3 concentration in the liquid phase.

By operating with maximum charges and keeping the NH_3 in solution under pressure, decided improvements may be made in the treatment of non-volatile substances. Thus in the preparation of 2-amino-anthraquinone it has been found that by increasing the size of the charge in the autoclave the reaction would take place with equal facility at slightly lower temperatures and at the same time permit of a much larger production of finished product.

Effect of Temperature.—Each convertible compound has a definite, characteristic, practical temperature zone in which the ammonolysis may be carried out. Within these limits the conversion of reacting compound to

amine takes place more rapidly as the reaction temperature is raised from the lower to the upper limits. Above the optimum high point decomposition takes place with the formation of condensation products and carbonaceous material. When the reaction temperature is too low the operation is not only unnecessarily prolonged but the yields are poor, owing to incomplete amination and the formation of intermediate hydroxy compounds. As the operating temperature is lowered from the upper to the lower limits, the increase in time required for amination increases in approximately a geometric ratio. The deleterious influence of working at low temperatures may be visualized from the curves.

Effect of Agitation.—The rate of amination depends upon the homogeneity of the reaction mass. Without agitation the aromatic compound would, on account of its greater density, settle to the bottom of the autoclave while the ammonia liquor remained as a distinct layer above it. Reaction would then take place only at the interface and a complete conversion to amine would be impossible.

In some operations, where no stirrers are provided, the mixing of the reacting materials depends on the convection currents produced by a flame at the base of the autoclave, or on forced circulation through a tubular system. The influence of speed of stirring on the reaction velocity of a number of unit processes has been worked out by Huber and Reid (*Ind. & Eng. Chem.*, Vol. 18, No. 5, 1926), who found that three classes existed: "(1) Those in which the rate of reaction is a linear function of the speed of stirring; (2) those in which this relation becomes linear only after a certain speed is attained, it being very slow without stirring, the rate increasing at first far more rapidly than the speed of stirring; and (3) those in which the rate is independent of the speed of stirring."

Table II—Preparation of 2-Amino-Anthraquinone Showing Effect of NH_3 Concentration

2-Chloro-anthraquinone, 12.125 grams; ammonia of strength indicated 200 grams; nitrobenzene 10 grams.

Time, Hours	Temp. Deg. C.	Strength NH_4OH Per Cent	Yield Per Cent	Purity of Product Per Cent	Net Yield, Per Cent
12.0	175	28.5	99.0	38.5	38.11
12.0	175	40.0	96.0	75.6	72.58
12.0	190	28.5	98.5	89.6	88.26
12.0	190	40.0	96.2	96.0	92.52
5.5	210	28.5	98.0	84.8	83.10
5.5	210	40.0	96.0	95.1	91.30

This amination process must be included in the second class, for without agitation the ammonia liquor would remain supernatant on the aromatic compound with practically no reaction taking place. A slight stirring brings about an increase in the reaction velocity, but a proportionate increase in the rate of reaction is not produced by a more vigorous agitation.

Influence of Common Solvent.—In the preparation of amines, the sulphonic acid derivatives of aromatic compounds are more easily converted than the respective halides. This is attributed to the greater solubility of the former inaqueous ammonical solutions and also to the fact that the former compounds dissociate in aqueous solutions to a greater extent, thus rendering the HSO_3 group more susceptible to replacement by ammonia. Since the aromatic halides are practically insoluble in water, it is often helpful to introduce an inert solvent in which the halide and NH_3 are both soluble. Thus, in the conversion of 2-chloro-anthraquinone it is advantageous to incorporate just enough nitrobenzene to disperse the halide in a collodial condition throughout the ammoniacal solution. In this way the reaction may be carried out under milder conditions and the necessity of using unusually strong ammonia liquor is obviated.

Alcoholic ammonia is often used in the ammonolysis of substituted toluenes, as the conversion may be made by merely refluxing within a mercury-sealed vessel. Amyl alcohol also has found considerable use in this field since it is an excellent solvent for both organic halides and NH_3. When this alcohol is used, a solution of the intermediate is first effected in the pressure vessel, after which NH_3 is admitted until the desired pressure is obtained. Heat is then applied so that the reaction may take place under optimum conditions.

When Catalysts Are Useful.—The use of copper catalysts to promote the substitution of NH_2 for halide should, it appears, be limited to the ammonolysis of compounds that will yield a liquid or volatile amino compound, or those that will remain in solution in the ammoniacal mother liquor. Under such circumstances the desired amine may be recovered by distillation, or separated from the copper compound by precipitating and then filtering. The patent literature is replete with extravagant claims of the beneficial effects obtained by the use of copper and its salts as catalysts for insoluble amines. Apparently, however, many of these claims are based more on tradition than on actual results obtained from scientific tests.

The foregoing statement refers only to the preparation of amines by treating substances with ammonia, and not to the preparation of such compounds as are obtained by condensing halides and amines in solution in the presence of copper salts, for that procedure is used extensively in making intermediates for vat dyes. Often the benefits derived from the use of copper may be obtained more economically by using a common solvent and a higher NH_3 concentration. In support of this contention data are available showing that, in the preparation of 2-amino-anthraquinone and amino condensation products derived from diphenyl, the incorporation of nitrobenzene instead of cuprous salts results in a better product with higher yields. Cuprous salts do, however, permit some reactions to take place under less drastic conditions of temperature and pressure, and also permit the use of a lower NH_3 ratio. The resultant product, however, is not as pure as that obtained by the use of specific solvents.

In addition to the preceding chemical factors, a large number of engineering functions are involved in this unit process. The most apparent of such chemical engineering activities include the mechanical assembling and delivery of raw materials; the control of temperature and pressure during ammonolysis; and the discharge and separation of the amine. The last step alone might include such unit functions as distillation, filtration, and crystallization.

Another important responsibility of the engineer relates to the selection of the most efficient type of pressure system, based on the dynamics of the reaction. The equipment may be designed for continuous or batch operations. The reaction vessels may be made from copper, steel, or ferrous alloys. They may be jacketed or designed for use with a metal bath, direct fire, or various types of electrical heaters. The autoclaves may be forge welded or of seamless construction. Finally, mechanical agitation may be provided, or the mixing of the ingredients may depend on convection currents set up by the heating apparatus.

Chemical Engineering Helps to

Charge of Ties in Retort Ready for Treatment

MUCH has been written and grave concern has been entertained among many classes of business on the arrival of what someone has termed "the new competition"—a competition seen as a tremendous economic battle between already established industries and new ones that are constantly springing up as a result of the achievements of the synthetic chemist and his energetic partner, the chemical engineer.

Inexorably the science of chemistry marches on, leaving in its wake the scarred remnants of once flourishing and seemingly impregnable industries. Seldom does modern progress, as expressed in chemical engineering advances, fail to capture some portions of the markets formerly enjoyed exclusively by older industries and products; still more rarely is chemistry responsible for the rejuvenation of a product which had begun to pass from the picture even before the significance of "the new competition" had been so clearly perceived.

But in the case of one product, and that a product which has figured in the affairs of man from the beginning, it decidedly has been the reviving force. Just at a time when numerous seers were predicting a certain and early demise, chemical engineering raised its hand and as a result timber, and particularly Southern pine timber, is experiencing a swift recrudescence as a structural material.

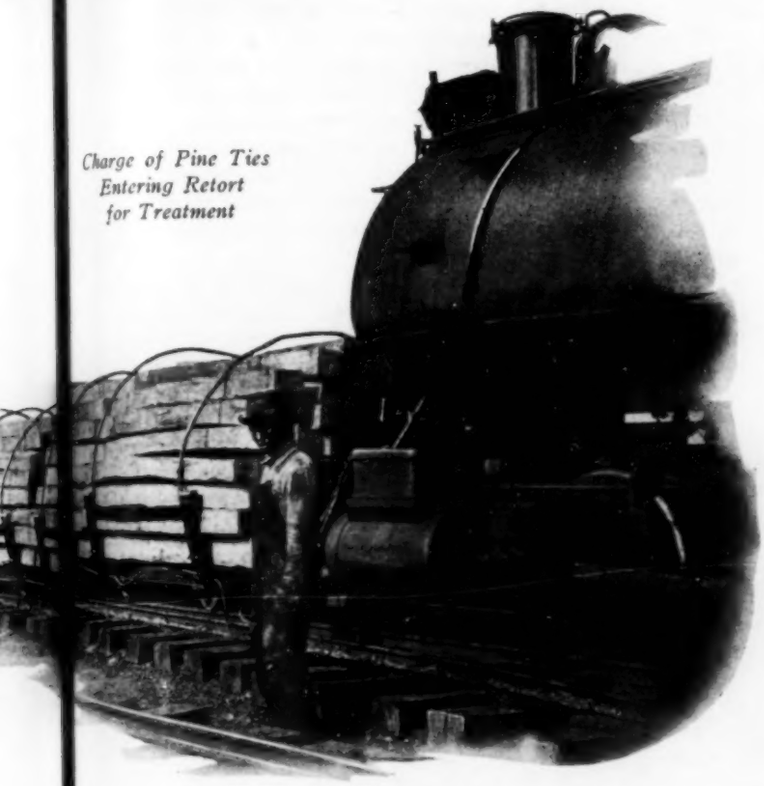
Chemical preservation of timber has been practiced in the United States for about 60 years, but only since 1920 has it assumed sufficient importance to be regarded as a major industry. In the years following the close of the World War a perceptible change began to take place. The impressive evidence of preserved timber still sound after more than 40 years of service in installations where untreated material decayed in one to two years could not be ignored. Production increased from 146,060,994 cu.ft. in 1919 to 345,685,804 in 1927, the last year for which complete data are yet available, and with it came a development of equipment and a standardization of method which put the industry for the first time in a position to go before the users of the country with the definite assurance that it had a product which could compare favorably with any of the other permanent structural materials.

Decay of untreated timber is caused by the action of certain fungi which consist of fine thread-like filaments that penetrate the structure in all directions, gradually break it down and in time produce a rotted condition. Local conditions govern the rapidity of growth, but in all cases there must be food, moisture, air and a favorable temperature. The removal of one of the four prevents fungus growth.

With this knowledge, wood preservation has developed around the principle of poisoning the food supply. Early efforts were not conspicuously successful because they were confined to the application of toxic substances to the surface of the material; later, soaking in a preservative was undertaken and as the necessity for deeper penetration became apparent, dipping in alternate hot and cold baths was tried.

In the meantime, a few individuals concluded that effective preservation could be obtained only by forcing the preservative deep into the timber structures. The first plant for doing this was erected at Brooklyn in 1872 but moved to Galveston the following year, where its operation was marked by signal success. A second

to Build a Great Southern Industry



Charge of Pine Ties Entering Retort for Treatment

By Dan Ravenel, Jr.

Jacobs & Company, Clinton, S. C.

plant was built in Mississippi in 1875 and a third at Slidell, La., a short time later.

Today, while a few users still believe that soaking in hot and cold baths is sufficient, and while a few timbers are unsuited for it, pressure treatment far overshadows any other. Standards for preservatives and for methods of treatment have been set up by a national organization, the American Wood Preservers' Association, and more and more are users the country over learning to accept them. Coal-tar creosote and zinc-chloride solutions are the two preservatives which the association recognizes. Both are highly toxic to fungous growth and to the various species of insects which prey on unprotected timber.

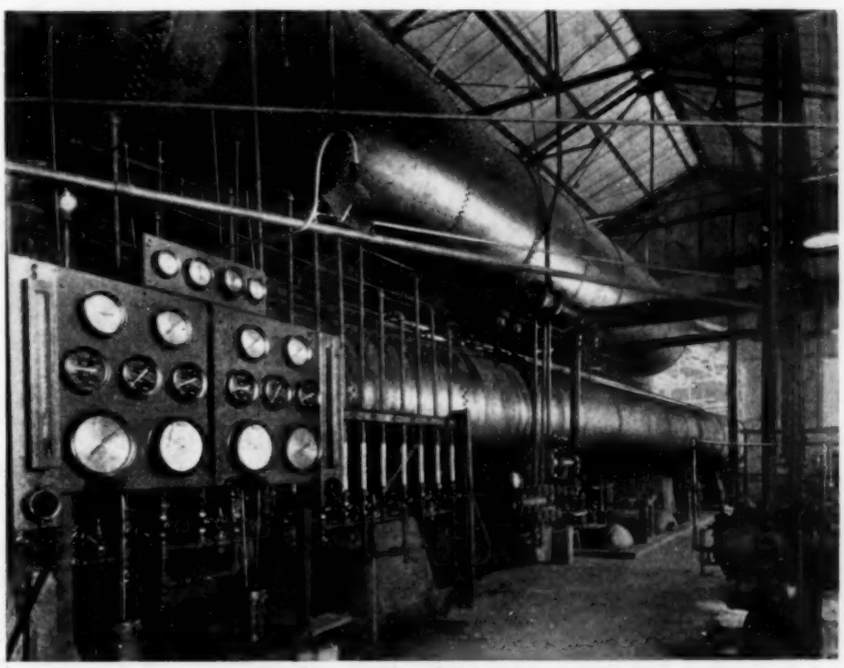
A clear understanding of how timber is preserved can best be obtained after a brief consideration of its structure. Unlike steel, which is a relatively solid material, wood is composed of many microscopic tubular fiber units or cells cemented together. Preservation is accomplished by forcing a preservative through these cells to a sufficient depth to prevent the possibility of fungous development even in the inner areas. Penetration, particularly where creosote is the preservative, is usually made to extend entirely through the sapwood, although for unusual conditions of service it can with proper equipment be carried into the heart as well.

How this is done and the equipment utilized can be gained from observing the plant and methods followed by the Taylor-Colquitt Company of Spartanburg, S. C., formerly a large dealer in untreated timber whose officers in 1925 decided to enter the expanding field of wood preservation.

Creosote is used exclusively as the preservative and the products are Southern-pine poles, piling, structural timbers and railroad crossties. In addition, a limited quantity of oak, hickory, beech and gum ties also is produced.

The plant, containing the most modern equipment obtainable and having a capacity of somewhat more than 100 million board feet a year, was designed by Grant B. Shipley of Pittsburgh. Aside from storage yards embracing 80 acres of ground, where large quantities of timber are kept stocked for air seasoning before treatment, it consists essentially of two independent treating units with necessary auxiliary machinery.

The principal element in each unit is a cylindrical plate steel retort 8 ft. in diameter by 114 ft. long into which timber is placed for treatment. With the retort are two other elements which have been developed

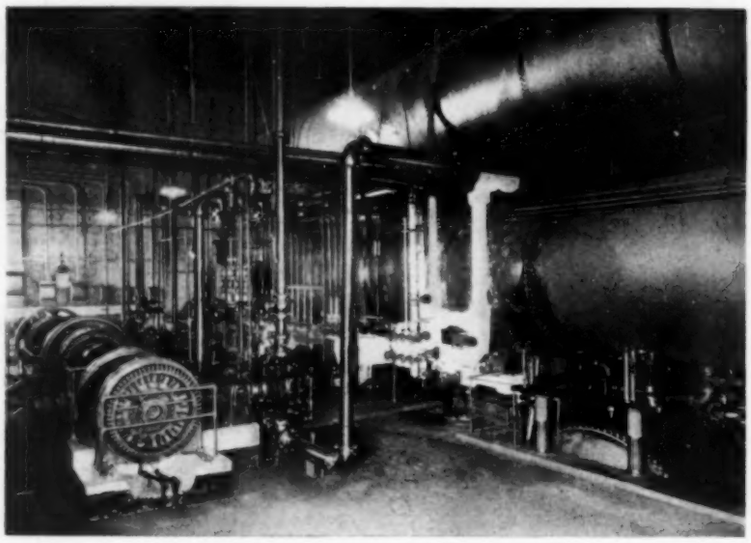


Interior of Treating Plant showing Retort, Reuping Cylinder, Pressure-Measuring Scale Tanks and Control

during the latter years of timber treatment to add to the exactness and the economy of the process. One of these is a Reuping cylinder, mounted above the retort, and the other is a pressure-measuring-scale tank located in a pit below. The function of the Reuping cylinder is to permit rapid filling of the retort with the preservative while the scale tank with its corollary equipment affords a means of determining the exact weight of creosote forced into the timber at any time during the process.

Two processes of treatment are used. One is called the empty-cell or Reuping while the other is the full-cell or Bethel. The distinction between them is this: The empty-cell process results in the internal cell walls of the timber being impregnated with creosote, but the cells themselves are emptied by means of entrapped air forced into the material before the admission of the preservative, which when pressure is relieved and a vacuum drawn, gives a "kick-back" effect. The Bethel process results in cell walls being impregnated and in the cells themselves being completely filled with preservative.

Except for conditions of unusually severe service, the empty-cell process is sufficiently effective and is preferred because less preservative is required for an equal depth of penetration. Where marine borer attack is to be encountered, and in some other classes of service, like the tropics, the full-cell method is employed.



Further Inside View of Taylor-Colquitt Treating Plant

The amount of creosote injected varies from 6 to 12 lb. per cubic foot of timber if the empty-cell process is used and from 10 to 24 lb. for full-cell treatment. Conditions of service and buyers' preferences are the determining factors.

In treating, seasoned timber after being carefully measured is carried into the retort on standard-gage tram cars. If the empty-cell process is to be used, an initial air pressure varying from 20 to 90 lb. is imposed as soon as the retort is sealed. From the Reuping cylinder above, which has previously been filled, creosote at a temperature of approximately 180 deg. is admitted to the retort. In its entry, it entraps the air previously forced into the cylinder and holds it until the end of the process, when the cellular spaces are to be emptied. When the retort is filled the connection between it and the Reuping cylinder is closed.

The pressure-measuring scale tank below the retort, which has also been filled before the beginning of the operation, is then brought into use. A pipe connection leading from the bottom of the scale tank to the bottom of the retort is opened, and a pressure of 150 to 200 lb. is imposed by means of air on the top of the scale tank. The creosote which enters the timber under the pressure is thus replaced in the retort by the flow from the scale tank.

This tank is mounted on accurate scales which can be seen at all times by the operator. It is therefore simple to ascertain how much creosote has been forced into the timber because the weight is the difference between the scale reading at the beginning and at any time later.

Time required for impregnation varies from two to six hours, depending upon the material and the quantity of preservative desired per cubic foot. Inasmuch as the cubical content of the material has been previously determined, and as the amount of preservative which will be brought out of the timber by the escape of the air is a known percentage of the entire quantity forced in, it can be ascertained from the scales when impregnation is complete.

When that point is reached, the connection between the retort and the scale tank is closed. The creosote in the retort is moved by air into the Reuping cylinder, the same quantity being returned there as was drawn from it at the beginning of the process. That done, the connection between the retort and the scale tank is reopened and a vacuum of 22 to 26 in. is drawn.

The vacuum permits the air entrapped in the timber to escape, but the creosote which it brings drains into the scale tank and is recovered. There it is weighed and the final retention of creosote in the timber is determined by taking the difference between the initial and final scale readings.

Where the Bethel or full cell process is to be used a vacuum is drawn on the retort at the beginning of treatment to exhaust the air inside the timber. Creosote is then admitted from the Reuping cylinder, and as in the empty-cell process, the connection is closed when the retort is filled. Pressure is applied from the scale tank and maintained until impregnation, as determined by scale observations, is complete. It then only remains to relieve the pressure, force the creosote from the retort to the Reuping cylinder, draw a quick vacuum to clear the surplus creosote and remove the timber.

Included in the auxiliary machinery are two electrically driven vacuum pumps, three high-pressure air compressors, and three air receivers. Recording instruments which keep a continuous record of time consumed in each treating operation, the pressure, vacuum and temperature maintained, together with prescribed reports from operators, showing the quantity of timber and the amount of creosote used on each charge, contribute to a uniform product.

Storage capacity for 550,000 gal. of creosote at the plant is available in five tanks. Heat for the creosote is supplied from steam boilers, which also serve occasionally for steam seasoning of timber in the retorts prior to treatment.

Industrial Advances and Farm Relief Reflect Chemical Progress

Editorial Staff Report

EDITOR'S NOTE—*One of the largest meetings of the American Chemical Society was held at Columbus, Ohio, April 29 to May 3. More than 1,800 members and guests attended the various sessions, visited local industries of northern Ohio and inspected the chemical and chemical engineering facilities on the campus of Ohio State University. Most of the divisional meetings were held in the new chemical laboratory which is just being completed. A brief report follows of the principal papers presented before the industrial division at its several sessions.*

SOME industrial interest was focussed in a symposium on "Economic Relations Between Chemistry and Farming" which featured the first general session of the A.C.S. meeting at Columbus. Louis J. Taber, National Grange master, declared that new uses for farm products and byproducts can do more toward farm relief than any legislation Congress may enact. He was directly supported in this view by H. W. Jeffers of the Walker-Gordon dairies of Trenton, N. J., who cited specific examples of scientific advances in processing feeds, increasing soil fertility and improving farm stock.

Chemical industry was well represented by papers from Major T. P. Walker, vice-president of the Commercial Solvents Corporation, and Charles H. MacDowell, president of the Armour Fertilizer Works. Among the interesting statistics cited by Major Walker was the statement that the production of butanol, acetone and ethyl alcohol in the United States now consumes annually 8,000,000 to 10,000,000 bushels of corn—or 25 per cent of that formerly employed in the manufacture of spirituous liquors. The total industrial consumption of corn was estimated to be between 90,000,000 and 100,000,000 bushels per year.

Fertilizer manufacture, according to Mr. MacDowell, whose paper was read by his associate, Fred S. Lodge, is now more nearly a heavy chemical industry than at any other time in its history. Consider these figures: Last year the industry produced 8,000,000 tons of commercial fertilizers valued at $225,000,000. Of this, 4,500,000 tons were super-phosphate requiring some 2,600,000 tons of 50 deg. sulphuric acid, which in turn accounted for a consumption of about 550,000 tons of sulphur. Byproduct coke ovens contributed 600,000 tons of sulphate of ammonia, while 650,000 tons of nitrate came from Chile and 150,000 tons of synthetic nitrogen products were imported from Germany. Potash in the amount of 800,000 tons came from Europe and 90,000 tons from California. Cyanamid from Canada and Europe was used to the extent of 75,000 to 100,000 tons.

Closely related to fertilizers in their value to agriculture are insecticides and sprays. These accounted for the bulk of the 23,000 tons of arsenic sold in the United States in 1928. In addition, hydrocyanic acid, nicotine salts, lead arsenate, copper sulphate and many similar chemicals find their principal application in this industry.

Referring further to the chemical trend in fertilizer manufacture, Mr. MacDowell said: "The advent of cheap synthetic ammonia has stimulated chemists and engineers to develop processes for the production of highly concentrated and refined salts designed for fertilizer use. When the problems of production and utilization are answered these chemical fertilizers probably will be of much significance in fertilizer economy. Indeed it is likely that they will in time displace some of the present lower analysis raw materials."

Power Plant Has Chemical Problems

ANOTHER symposium, conducted by the industrial division, dealt with the chemical problems of the boiler room and power plant. Under the chairmanship of Dr. W. D. Collins of the U. S. Geological Survey this discussion centered largely on the treatment of boiler waters, although, as pointed out by Lincoln T. Work of the chemical engineering department of Columbia, equally significant problems are presented in (1) the properties of metals, (2) selection and processing of fuels, (3) reactions in combustion, (4) selection of lubricants and (5) fusion reactions of ash and slags.

In the discussion of feed waters, A. H. Reynolds of the Dearborn Chemical Company showed how commercial tannin extracts, such as chestnut-oak, are efficient in removing dissolved oxygen from boiler waters and thereby controlling corrosion in many cases. Boiler pressures up to 130 lb. do not destroy this oxygen-absorbing power.

Operating results, according to E. M. Partridge of Paige & Jones Chemical Company, also show that harmful scale formation may be prevented at low cost through the use of organic matter in conjunction with quantities of inorganic chemicals far below the amounts necessary to react chemically with the scale-forming constituents of the feed water. The organic matter possibly acts in such a manner that the calcium sulphate and other solid materials formed during evaporation are kept in suspension rather than carried down as a sludge. The best results have been obtained by combining the lime-soda softener with the treatment with organic material.

A zeolite deconcentrator combination for boiler water purification was described by Elwood W. Scarritt. The use of a deconcentrator to remove solids formed when water treated by the zeolite system is mixed with raw

water eliminates many of the undesirable features of the zeolite softened water. The reaction between the soft and hard water creates a sludge which is uniformly and continuously removed from the boiler by the deconcentrator system. The high caustic concentration resulting from the zeolite system is replaced by insoluble matter. The normal sulphate content of the raw water provides in the majority of cases an adequate sulphate-alkalinity ratio for the prevention of embrittlement. The system also minimizes the blow-down required to prevent foaming caused by a high concentration of sodium salts. In a 200-day test on a small boiler using 40 per cent make-up, the blow-down was less than 0.5 per cent. No scale was formed. The system may result in a saving of 80 per cent of the quantity of softened water used, according to Mr. Scarritt.

Recent development of high-pressure boilers operating at 400 to 1,200 lb. per square inch pressure and even higher and producing high rates of evaporation has made it necessary to devise improved equipment for the various methods of water purification. Joseph D. Yoder of the Cochrane Company showed practical methods of treating water with phosphate to supplement the hot process lime-and-soda or lime-and-gypsum treatment. De-aerators are used to supplement this treatment for boilers operating above 400 lb. The apparatus used for adding sulphuric acid to zeolite softened waters must be designed with particular attention toward preventing corrosion by this acid. In all cases where a solution is added to the feed water, the proportioning is accomplished by balancing the differential pressure caused by the water flowing through an orifice with a corresponding pressure of the solution passing through a smaller orifice.

Catalysts for Inorganic and Organic Reactions

PLATINIZED silica gels as catalysts for the oxidation of sulphur dioxide were described by Holmes, Ramsay and Elder of Oberlin College at the session of the industrial division on May 2. Robert E. Wilson of the Standard Oil Company of Indiana presided. In the paper presented by Professor Holmes comparisons were made between his "chalky" gel, Patrick's gel and asbestos as carriers for the platinum. In every case the "chalky" gel gives better efficiencies of oxidation with small amounts of platinum. When larger quantities of platinum were used the two gels gave practically the same results, which were in all cases better than the results with asbestos. The conversions ran as high as 97 per cent.

An interesting result of the experiment was that the temperature necessary to effect the maximum oxidation decreases linearly as the quantity of platinum is increased. A discussion of this paper had to do with the similarity of this catalyst and other surface catalysts, and some speculation was voiced regarding the rôle of porous catalysts in gas reactions of this kind.

A second paper by Frolich and Cryder of Massachusetts Institute of Technology described decomposition and synthesis experiments using chromium-zinc oxide catalysts with methanol, carbon monoxide and hydrogen. The correlation of the decomposition reactions at atmospheric pressure with the synthesis at 3,000 lb. was indicated. The best catalyst for synthesis was one containing four mols of zinc oxide to one of chromium oxide. The results in general were similar to those obtained with copper-zinc oxide mixtures.

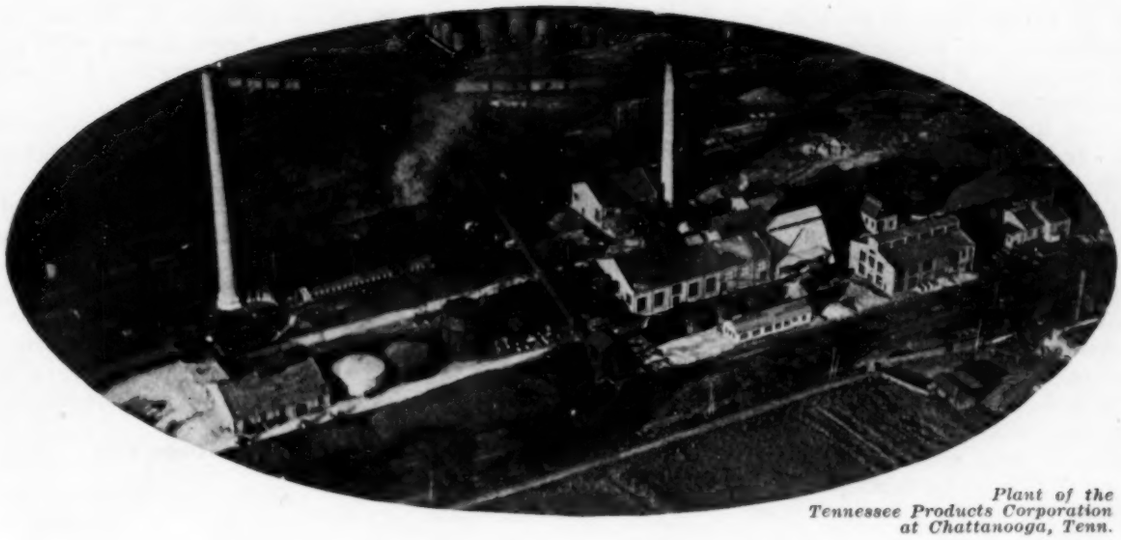
The soil corrosion studies now being conducted by the Bureau of Standards in about fifty different soils throughout the United States were discussed by H. D. Holler. He referred particularly to the attempt to correlate the rates of corrosion observed on specimens of ferrous pipe materials with the character of the soils in which they were buried. In the more humid areas of the United States, the initial rate of corrosion appears, with few exceptions, to be closely related to the acidity of the soil. In the more arid regions, corrosion appears dependent not only upon the amount but also upon the kind of salts present in the soil. The corrosiveness as well as the acidity and salt content of the soils are dependent upon climatic conditions, particularly rainfall.

Ralph E. Montonna and John L. Tronson of the chemical engineering department at the University of Minnesota described distillation studies in which the reflux ratio and rate of distillation were varied and the efficiency of bubble-cap columns determined. To secure the maximum column efficiency, at least three to four times the theoretical minimum reflux should be used. It was found that for the column used in these experiments a feed which corresponded to a vapor velocity rate of about 7 ft. per second through the cap slots could be moved through the column without loss of efficiency. It also was shown that the point of entrance of the feed into the column has a marked effect on the column efficiency. All experiments were made on the system water-ethyl alcohol.

The final paper of the session was that of Dr. Charles W. Cuno, consulting chemical and metallurgical engineer for the Industrial Bureau of the Industrial Club of St. Louis, who spoke on "Sound Industrial Developments." Industries migrate, he said, according to definite economic factors of plant location. This migration proceeds irrespective of overcapacity in other locations, of overproduction, of periods of depression; in spite of highly organized selling forces and the most ruthless competition.

Broadly speaking, twelve factors govern the location of an industry in a given metropolitan area, and six more or less static factors—labor, transportation facilities, freight rates, climate, taxes, and metropolitan restrictions—give a city its strategic location in relation to chemical industries. Raw materials, water, fuel, power, markets and competitive, consumer and feeder industries are subjects for engineering research by cities that are interested in attracting chemical industries.

A classification of industries given by Dr. Cuno was as follows: basic, intermediate, and tributary. For the development of basic industries, the first interest of a community should be to develop its sources of fuel and power. Other major raw materials must be obtained advantageously or at least on a competitive basis. Intermediate industries prosper, first, when their raw materials can be obtained advantageously from local basic industries; second, when obtaining these on a highly competitive market, they are able to sell advantageously in at least a portion of the national market. Tributary industries may be fostered by any community. They prosper only to the limit of their markets, which include the local market, due to protective freight rates, and a limited outside market, due to freight differentials. Thus it is seen that also for tributary industries, the major governing factors are again distribution facilities, freight rates, magnitude of markets and labor conditions.



Plant of the Tennessee Products Corporation at Chattanooga, Tenn.

Will It Pay to Process Coal for Generating Power?

A comparison of operating and investment costs for various methods of gas production

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ENGINEERS have made claims as to the possibilities of reducing the cost of generating electric energy through a decrease in cost of boiler fuel by processing coal with a recovery of byproducts. It is self-evident that the cost of boiler fuel can be decreased by processing the coal only if the revenue derived from the sale of byproducts is greater than the costs of conversion. Undoubtedly, a heat unit in the form of gas is more valuable for firing boilers than a heat unit in solid form; but for gas firing to be profitable the net cost of the gaseous heat unit cannot much exceed that of the solid.

To determine the possibilities of generating electric energy more cheaply, eight studies were made to discover how different types of gas plants, variously operated, in combination with a steam-electric generating station compare as to investment and operation cost with a modern coal-fired steam-electric power plant (actual figures from the Toronto station of the Ohio River Edison Company were used). Beyond the fact that the power-generating plant shall be located favorably with respect to coal and water, we have considered no particular locality, but have assumed a district capable of consuming the output of a 150,000-kw. plant operating with an average load factor of 60 per cent.

As with electricity, the gas consumption in any given district is a function of many varying factors and does not necessarily parallel that of power. Consequently, without having a definite district designated, it is impossible to determine the relative loads for electricity and gas. However, it appears that in the average American community approximately 10 cu.ft. of gas is distributed for every kilowatt-hour of electricity consumed.

The principal markets for coke are for foundry and blast-furnace use, water-gas manufacture and the domestic trade. The demand for metallurgical coke is a direct function of the prosperity of the country, and so fluctuates widely. The demand for power is not affected to so marked a degree by business conditions. Therefore it would be unwise to have the economic future of a power plant dependent upon the marketing of a product subject to such wide fluctuations in demand.

The market for coke for water-gas manufacture is relatively small and cannot be depended upon as an outlet for the entire production of coke from such plants as described in this report. The domestic coke market is not much affected by the general business conditions of the country. While there may be minor fluctuations, the general trend from year to year is toward a broader market for this satisfactory smokeless fuel.

On account of the wide fluctuations in the per-capita consumption of electricity for power in different com-

munities it is impossible to establish any very definite ratio between its total consumption and the consumption of domestic fuel. While data are available as to the total consumption of electricity in some definite areas, similar data for the same areas on the consumption of domestic fuel are not available. However, data are obtainable from which generalizations may be drawn.

From widely varying ratios we deduce that the solid domestic-fuel consumption in a district is about 0.002 ton (4 lb.) per kilowatt-hour. However, even with this high ratio of consumption it is found that the entire requirement of solid domestic fuel in the area of power distribution is barely sufficient to absorb all the coke produced in a combined byproduct-coke-oven power-generating station. As it is improbable that coke can entirely displace other solid domestic fuels already in use, even with extreme price concessions, it is self-evident that outside markets must be developed for the disposal of a considerable part of the coke production.

AMMONIUM SULPHATE has a well-established market as a fertilizer element and is the base for the manufacture of other ammonium compounds. Its consumption in the fertilizer industry is increasing more rapidly than its production in byproduct-coke-oven plants, the demand being met more and more from synthetic-ammonia plants. In these studies the maximum production contemplated is only a small part (not exceeding 5 per cent in any case) of the total from all byproduct-coke-oven plants in the country, so it should be marketable without difficulty at standard prices through established channels.

Coke-oven tar also has a well-established market, being the raw material for the manufacture of many products. The creosote oils are used principally as wood preservatives and the pitch and heavy oils for road building. Here, as in the case of the ammonium sulphate, owing to the relatively small amount produced there should be no difficulty in disposing of the entire production at standard market prices.

Low-temperature and water-gas tar have not as well established markets, and there will be greater difficulty in their disposal than with coke-oven tar without marked price concessions.

Refined light oils are used as solvents in many industries and as bases for numerous dyes, pharmaceuticals and explosives. In excess of these requirements light oil is used in the preparation of anti-knock motor fuel.

Table I—Yields Used in Estimating

Products	Quantity per Ton Coal Processed
Coke, lb.	1,300
Breeze, lb.	140
Ammonium sulphate, lb.	25
Light oil, gal.	3
Coke-oven tar, gal.	10
Water-gas tar, gal.	20
Low-temperature tar, gal.	27
Total oven gas, cu.ft.	11,082
Oven gas to underfire ovens, cu.ft.	4,182
Surplus oven gas, cu.ft.	6,900
Blue gas from coke, cu.ft.	41,143
Blast gas from coke, cu.ft.	41,142
Blue gas from coal, cu.ft.	57,143
Blast gas from coal, cu.ft.	57,143
Retort gas, cu.ft.	92,800

The plant scheme selected for study has an installed capacity of 150,000 kw., consisting of three multi-stage condensing turbine-generating units. The steam equipment consists of six 21,000-sq.ft. boilers which furnish steam at 600 lb. and 725 deg. F. The feed-water makeup from single-effect evaporators, together with the turbine condensate, is preheated to 360 deg. F. in two open-type and one closed-type heaters with steam bled from the turbines. The temperature of the stack gases leaving the economizers is 300 deg. F.

When the power-generating plant is gas-fired the power units remain the same as in the coal-fired installation except as to coal-handling equipment. For gas firing, simple bunsen-type burners are installed.

For the coke-oven installation the modern regenerator type of oven has been used. The ovens have a capacity of 14.31 tons of coal per charge, and when operated at full capacity have a throughput of 28.62 tons per day.

The byproduct equipment is of sufficient size to handle all the products when the ovens are operated at maximum speed. In all cases tar, light oil and ammonium sulphate are recovered. Sufficient storage capacity is provided for these products to insure economical marketing.

Table II—Quantities Used

To Carbonize Coal in Ovens	Quantity per Ton Coal Processed
B.t.u.	2,300,000
Oven gas to underfire ovens, cu.ft.	4,182
Blue gas from coal to underfire ovens, cu.ft.	7,667
Blue gas from coke to underfire ovens, cu.ft.	7,931
To Dilute Total Oven Gas	
Blue gas from coal, cu.ft.	964
To Dilute Surplus Oven Gas	
Stack gas, cu.ft.	260
Blue gas from coke, cu.ft.	575
Water-Gas Manufacture	**Quantity per MCF Produced**
Coke, lb.	35
Coal, lb.	35
Steam, lb.	36.85

The gas-handling equipment is varied to meet the conditions in each case. When the gas is sold, sufficient purifying equipment is provided to meet the maximum demand load, together with the necessary mixing devices to reduce the calorific value of the gas to the desired standard. Sufficient holder capacity also is installed to meet the varying load conditions of gas sales and to cover any inequalities in production.

WITH the use of gas as boiler fuel no purifying or mixing equipment is provided, but sufficient holder capacity is supplied to meet maximum daily and weekly peak-load requirements in the generating unit and to cover any inequalities in gas production. Blue-gas equipment is provided as auxiliary to the oven equipment where necessary. The coal-handling and coke-handling equipment is varied to meet the conditions.

In all installations sufficient dry quenching equipment is provided to handle the maximum coke production. No extra boilers are provided, as the dry quenching equipment furnishes sufficient steam to meet all steam and power requirements of the oven plant.

The blue-gas generators provided are of two types: (*a*) When the blue gas is used primarily to underfire the ovens or to mix with the oven gas for sale, the equipment consists of the most modern type of 11-ft., three-shell machines.

(*b*) When the gas produced is used as boiler fuel, the equipment consists of an adaptation of the single-shell generator.

The complete-gasification units considered in this study are of the retort type employed by Bussey at Louisville, Ky., and by Maclaurin at Glasgow, Scotland; but modified in design so that complete gasification results, as in the modified Mond producer.

The operation of the retort is continuous, coal being

Table III—Calorific Values

	B.t.u.
Coal at Toronto and into retorts, per lb.	12,300
Coal into ovens and generators, per lb.	13,900
Coke as produced, per lb.	13,200
Breeze as produced, per lb.	12,900
Tar (oven, water, gas and low temperature), per gal.	145,000
Light oil, per gal.	135,000
Oven gas as produced—standard conditions, per cu.ft.	550
Oven gas as sold—standard conditions, per cu.ft.	530
Blue gas from coal—standard conditions, per cu.ft.	300
Blue gas from coke—standard conditions, per cu.ft.	290
Blast gas—standard conditions, per cu.ft.	81.5
Retort gas—standard conditions, per cu.ft.	206.5

introduced at the top at the rate of 25 tons a day and ashes being removed at the bottom directly into cars. The blast air is introduced into the ash bed, and steam is introduced at different levels into the incandescent coke. The hot blast (producer) gas and blue gas pass up through the down-coming coal stream, thereby driving off the volatile matter and converting the coal to coke, the coke being reacted upon in the lower section of the retort, first by the steam and then by the blast, until only ashes remain.

The products of the complete gasification (blast gas, blue gas and carbonization zone gas) leave the top of the retort and are handled in standard condensing and scrubbing equipment for the recovery of light oil and tar before they are fired under the boilers.

The coal-handling equipment is very simple, consisting only of track hoppers and skip hoist with no crushing, disintegrating or screening equipment.

All values used have been conservatively estimated from known operating results obtained in the industries from high-volatile coal, as shown in Tables I, II and III.

Three cases have been considered where the sale of gas enters into the cost of power.

In Study No. 1 only the surplus oven gas, amounting to 6,900 cu.ft. per ton of coal carbonized, is available for sale. After mixture with stack gas to reduce its calorific value to the desired standard, the total volume available is 7,160 cu.ft. The ovens are considered as operated in parallel with power production, and so the greatest gas production is during the period of peak demand for both electricity and gas. With a plant thus operated the oven gas furnishes the same proportion of the gas load of the district throughout the year, the proportion in this case being 52 per cent. As a fair market value for the gas we have used 30c. per thousand cubic feet at the plant. The annual revenue amounts to $1,232,961, or $0.00156 per kilowatt-hour produced.

In Study No. 2 the entire production of oven gas, amounting to 11,082 cu.ft. per ton of coal carbonized, is available for sale. After mixture with 300-B.t.u. blue gas from coal to reduce its calorific value to the desired standard, the total volume available is 12,046 cu.ft. Here, as in the previous case, the ovens are considered as operated in parallel with power production, and the maximum gas production is during the period of peak demand for both electricity and gas, which run parallel. With a plant thus operated the oven gas furnishes the same proportion of the gas load of the district throughout the year, about 88 per cent. The total revenue from gas amounts to $2,074,336, or $0.00263 per kilowatt-hour produced.

Table IV—Revenue from Ammonium Sulphate

Boiler Fuel	Annual Revenue	Revenue per Kw.-Hr.
Coke and breeze	$215,252	$0.00027
Oven gas and breeze	778,529	.00099
Oven gas	738,324	.00094
Oven, blue and blast gases	203,330	.00026
Blue and blast gases	247,985	.00031

IN STUDY No. 6 only the surplus oven gas (6,900 cu.ft. per ton of coal carbonized) is available for sale. After mixture with 290-B.t.u. blue gas from coke to reduce its calorific value, the total volume is 7,475 cu.ft. In this study the ovens are considered as operated at maximum speed throughout the year, and consequently produce the same quantity of gas daily, this quantity being the minimum amount required by the district on any day during the year. Hence the oven gas supplies the base load of the district, about 63 per cent of the annual consumption. Here, as in the two previous cases, the value of the gas is taken as 30c. per 1,000 cu.ft. The annual revenue amounts to $1,482,952, or $0.00188 per kilowatt-hour produced.

Two cases have been considered where the sale of coke enters into the cost of power:

In Study No. 3 the domestic-coke production closely approximates the entire solid domestic-fuel requirement of the district supplied by the power plant, and so, as a large proportion will have to be disposed of in outside markets requiring a freight haul, $4 per ton has been considered a fair price at the ovens when raw coal costs $2.65 a ton. With this price of $4 a ton the coke, after leaving the plant, bears all costs incidental to its sale, the differential between coal and coke, dealer's margin, sales expenses and freight. With a production of 1,349,450 tons the annual revenue is $5,397,800, or $0.00684 per kilowatt-hour produced.

In Study No. 4 the quantity of domestic coke to be sold is reduced slightly as compared with the previous case, but still leaves more than can be absorbed in the district supplied with power. Here again the fair price for the coke has been taken as $4 per ton at the ovens. With a production of 1,144,304 tons the annual revenue is $4,577,216, or $0.00581 per kilowatt-hour produced.

Table V—Revenue from Sale of Tar

Boiler Fuel	Kind of Tar	Total Revenue	Revenue per Kw.-Hr.
Pulverized coke and breeze	Coal	$344,402	$0.00044
Pulverized coke and breeze	Coal and water gas	431,098	.00055
Oven gas and breeze	Coal	1,245,646	.00158
Oven gas	Coal	1,181,319	.00150
Oven, blue and blast gases	Coal	325,328	.00041
Blue and blast gases from coke	Coal	396,776	.00050
Blue and blast gases from coal	Water gas	547,300	.00069
Retort gas	Low-temperature	890,120	.00113

The sale of ammonium sulphate enters into the cost of power wherever a byproduct-coke oven plant enters into the study, or in six of the set-ups, two of which are identical as to the quantity of coal carbonized in the ovens. Ammonium sulphate has a present actual market value of more than $40 a ton, but in consideration of the prospective large increase in synthetic ammonia production we have estimated the fair return for ammonium sulphate as $30 per ton at the ovens. The annual revenue derived from the sale of ammonium sulphate in the five cases and the revenue per kilowatt-hour produced are given in Table IV.

The sale of tar is a factor in the cost of power in all cases studied. The market for byproduct-coke-oven tar has been gradually strengthening, with every indication that its price will be still higher in future. On this account we have taken the present market value of 6c. a gallon as being a fair return for the tar at the ovens. The market for water-gas and low-temperature tars is not as well developed as that for coal tar, but all indications are that these will follow the market trend of coal tar, especially because they contain phenolic components required in the manufacture of synthetic resins,

such as Bakelite. However, we believe that a differential should be established and consider 5c. a gallon at the plant a fair market value for this class of tars. The annual revenue derived from the sale of tar and the revenue per kilowatt-hour produced are given in Table V.

THE sale of light oil is a factor in the cost of power in all cases studied except where the coal is processed in generators. The present market value of crude light oil varies between 10c. and 13c. a gallon, depending on whether the district where it is produced is near a market for "pure" products. The prospects are that the demand for light oil will increase more rapidly than production, but nevertheless we have placed the conservative value of 10c. a gallon at the plant as a fair market value for this product. The annual revenue derived from the sale of crude light oil and the revenue per kilowatt-hour produced is as shown in Table VI.

Consider a theoretical 150,000-kw., 600-lb. pressure, straight steam plant using pulverized coal such as is now being consumed at Toronto station. To arrive at the cost of power, 15 per cent of the capital investment is taken to cover depreciation and fixed charges. A working capital account is set up for moneys invested in stocks of coal, payroll and plant charges for a 60-day period, and in the miscellaneous store of repair parts and supplies, 10 per cent of the aggregate value of these items being taken as a fair charge for interest and depletion. The coal cost is taken at $2.15 per ton. With these conditions the net cost of power generated, not including any distribution cost, is calculated at $0.005215 per kilowatt-hour.

Consider an identical straight steam plant using Pittsburgh seam coal, suitable either for steam generation or for byproduct-coke ovens or water-gas generators. Under the same conditions as before, but with the coal costing $2.65 a ton, the net cost of power is calculated as $0.005298 per kilowatt-hour.

These two cases are considered typical of the cost of generating power in the modern-type straight steam plant, no account being taken of distribution costs or of profit accruing to the investment.

In the first study, where a coke-oven plant is combined with the power-generating station, the basis is the sale of the surplus oven gas and the consumption of the resultant coke and breeze as pulverized fuel under the power-plant boilers.

To arrive at the cost of power generated, the same set-up is used as that for the theoretical straight steam plant, with the addition of a charge in the working capital account for byproducts carried in stock or as bills receivable for a 60-day period. A credit at fair market value is taken for the byproducts—gas, ammonium sulphate, tar and light oil. Pittsburgh seam coal is carbonized in the ovens, its cost being $2.65 a ton delivered.

In this study the large increase in operation expense, fixed charges and coal cost is more than offset by the revenue derived from the sale of byproducts. The net cost per kilowatt-hour is calculated as $0.004938, with a total indicated annual saving over the theoretical straight steam plant of $218,644, or 4.75 per cent on the additional capital investment.

The economic advantage of this set-up disappears when the coal for the ovens costs over $3 a ton as compared with $2.15 coal for firing in the straight steam plant. The economic advantage also disappears if the price of the gas sold is reduced to 23c. per 1,000 cu.ft. instead of 30c.

THE second study, where a coke-oven plant is combined with the power generating station, is predicated upon the sale of the total gas production of the ovens, this necessitating underfiring the ovens with auxiliary fuel (blue gas made from coal), and the consumption of the resultant coke and breeze as pulverized fuel under the power plant boilers.

In this study the same set-up is made as in the previous case, and, although there is an increase in operation expense, fixed charges, etc., due to the inclusion of blue gas generators, nevertheless the net cost of power is reduced by the greater revenue derived from the sale of gas. The net cost of power is calculated as $0.004476 per kilowatt-hour, with a total annual saving over the straight steam plant of $582,957, or 10.38 per cent on the additional capital investment.

The economic advantage of this set-up disappears when the coal for the ovens costs over $3.50 a ton as compared with $2.15 coal for firing in the straight steam plant. The economic advantage also disappears if the price of the gas sold is reduced to 22c. instead of 30c.

The third study, where a coke-oven plant is combined with the power generating station, is predicated upon the sale of the coke production as domestic fuel, and the burning of pulverized breeze and surplus oven gas under the power-plant boilers. The cost of power is calculated as $0.006151 per kilowatt-hour, 18 per cent more than the cost in the straight steam plant, or a total annual loss of $738,009.

The fourth study, where a coke-oven plant is combined with the power generating station, is predicated upon the sale of the net coke production as domestic fuel and the burning of the total oven gas under the power plant boilers, the ovens being underfired with auxiliary fuel —i.e., with blue gas made in generators from a portion of the coke and all the breeze from the ovens.

Table VI—Revenue from Sale of Light Oil

Boiler Fuel	Total Revenue	Revenue per Kw.-Hr.
Pulverized coke and breeze	$172,201	$0.00022
Oven gas and breeze	622,823	.00079
Oven gas	590,660	.00075
Oven, blue and blast gases	162,664	.00021
Blue and blast gases from coke	198,388	.00025
Retort gas	197,804	.00025

Increased operation expense and fixed charges resulting from the installation of a blue-gas plant, together with a smaller revenue from byproducts, increases the cost of power over that shown in the preceding study. The cost of power is calculated as $0.007627 per kilowatt-hour, 45 per cent more than the cost in the straight steam plant, or a total annual loss of $1,901,591. This loss would be entirely offset if the coke were sold for $6 a ton instead of $4 a ton as set up.

The fifth and subsequent studies are predicated upon the complete gasification of the coal by means of ovens and generators, or generators, or retorts as indicated.

In the fifth study the coal is carbonized in a by-product-coke-oven plant, which, when operated at 100 per cent rating, has a capacity in coke and gas equivalent to the annual fuel requirement of the power-generating station. The surplus gas production is continuously consumed under the power-plant boilers and the coke and breeze production is gasified as needed in blue-gas generators, which have a capacity equal to the fuel requirements of the power plant when operated at 100 per cent load factor.

The capital investment, due to the saving in equipment for handling and pulverizing the fuel and to the smaller

oven plant required, is less than in any of the preceding studies. However, on account of the decrease in revenue derived from the sale of byproducts, the cost of power is greater than in the theoretical straight steam plant, being $0.006627 per kilowatt-hour, an increase of 27 per cent with an indicated annual loss of $1,113,561.

The sixth study is the same as the fifth except that instead of burning the surplus oven gas under the power-plant boilers it is sold as the base load of the local distributing companies. The fixed charges, due to a slightly greater capital investment, and the operation expense are both higher than in the preceding study, but the increased cost is more than compensated for by the increased revenue derived from the sale of the gas.

The cost of power under this scheme of operation is calculated as $0.0055 per kilowatt-hour, 5.5 per cent more than the cost in the straight steam plant, or an indicated annual loss of $224,916. Power could be produced as cheaply under this set-up as in the theoretical straight steam plant if the surplus gas were sold for about 34c. instead of 30c., or if coal suitable for the ovens could be purchased for $2.30 per ton instead of $2.65.

In the seventh study a blue-gas generating plant is the medium utilized for the complete gasification of the coal. In this the only byproduct recovered is water-gas tar, all other products of the coal conversion being consumed under the power-plant boilers.

The capital investment for the combined gas-steam generating plant is smaller than in any of the preceding studies, due to the elimination of the pulverized-fuel equipment at the boilers and the simplicity of the single-shell generating units. While fixed charges are less compared with preceding studies and operation costs are moderate, the cost of power is high due to the small revenue derived from the sale of byproducts. The net cost of power is calculated as $0.00621 per kilowatt-hour, 19 per cent more than the cost in the straight steam plant, or an indicated annual loss of $784,518.

In the eighth and final study a retort plant is the medium utilized for the complete gasification of the coal. All the products, except tar and light oil, are burned under the power-plant boilers. Here the capital investment for the gas-steam generating plant is the least in any of the studies, and is only slightly greater than for the straight steam generating plant alone. With fixed charges only slightly greater than for the straight steam plant, the increased operation expense and additional cost of coal is more than offset by the revenue derived from the sale of tar and light oil.

The net cost of power is calculated as $0.004939 per kilowatt-hour, a total indicated annual saving over the theoretical straight steam plant of $217,321, or 171 per cent on the additional capital investment.

WHILE the indicated annual saving is more than double ($582,927) in the set-up where pulverized coke and breeze are burned under the boilers and the total oven gas made is sold, nevertheless the return on the additional capital required is only 10 per cent as compared with 171 per cent when the coal is completely gasified in retorts. The studies are summarized in Table VII.

The following conclusions are derived from these studies:

1. With a combined coke-oven power-generating plant it is possible to generate power with coke and breeze more cheaply than in a straight steam-generating plant. However, the returns on the additional capital investment in the coke-oven plant are only 5 per cent to 10 per cent, an amount insufficient to justify the construction of such a combined plant.

2. With a combined complete-gasification retort power-generating plant it is possible to generate power more cheaply than in a straight steam-generating plant, but not as cheaply as in a combination coke-oven power-generating plant using pulverized coke and breeze as fuel.

3. That any combined gas-electric plant dependent upon the sale of coke as a byproduct is unprofitable due to the large increase in capital investment required and also due to the difficulty of disposing of large quantities of coke at a price sufficiently high to cover conversion costs.

4. That there is not sufficient justification for building a combined gas-electric plant that is dependent upon the sale of gas as a byproduct, owing to the large increase in capital investment required.

5. That a combined gas-electric plant is profitable only if its cost is equal to, or but slightly exceeds, the cost of a straight steam generating plant.

6. The capital requirement for any combined gas-electric plant, where provision is made for the recovery of all byproducts from coal processing and their preparation for marketing, is so much greater than for a straight steam-generating plant that the possibility of cheapening electric power generation by processing bituminous coal appears remote.

This article is based on an engineering report prepared for Stevens & Wood, Inc., New York City. Acknowledgment is hereby made of the courtesy of this company in making this information public.

Table VII—Summary Cost of Power in 150,000-Kw. Plant—Capacity Use, 60 Per Cent

	Steam Generated with						Products of Complete Gasification			
	Pulverized Coal—Low-Grade Coal	Pulverized Coal—High-Grade Coal	Pulv. Coke and Breeze Surplus Oven Gas Sold	Pulv. Coke and Breeze Total Oven Gas Sold	Surplus Oven Gas and Pulverized Breeze	Total Oven Gas	Surplus Oven Gas, Blue and Blast Gases	Blue and Blast Gases from Coke	Blue and Blast Gases from Coal	Retort Gas
Capital Investment:										
Power plant	$17,073,000	$17,073,000	$17,073,000	$17,073,000	$17,073,000	$15,500,000	$15,500,000	$15,500,000	$15,500,000	$15,500,000
Gas plant	.....	.....	4,600,000	5,607,000	17,500,000	21,600,000	4,400,000	5,400,000	2,200,000	1,700,000
Total	$17,073,000	$17,073,000	$21,673,000	$22,680,000	$34,573,000	$37,100,000	$19,900,000	$20,900,000	$17,700,000	$17,200,000
Cost per Kw.-Hr. Produced—Mills										
Oper. labor, maint. and supplies	0.595	0.595	1.257	1.460	2.434	2.728	1.792	2.102	1.612	1.161
Interest and depletion	0.048	0.049	0.120	0.149	0.365	0.212	0.103	0.150	0.085	0.088
Fixed charges, 15 per cent	3.248	3.248	4.124	4.315	6.578	7.059	3.786	3.976	3.367	3.272
Coal	1.324	1.406	1.929	2.221	6.978	6.618	1.822	2.222	1.840	1.798
Total operation expense	5.215	5.298	7.430	8.145	16.355	16.617	7.503	8.450	6.904	6.319
Revenue from byproducts	.....	.....	2.492	3.669	10.204	8.990	0.876	2.950	0.694	1.380
Net operation expense	5.215	5.298	4.938	4.476	6.151	7.627	6.627	5.500	6.210	4.939
Change in cost of power—mills	.....	+0.083	—0.277	—0.739	+0.936	+2.412	+1.412	+0.285	+0.995	—0.276
Additional Investment										
Gross amount	.....	.....	$4,600,000	$5,607,000	$17,500,000	$20,027,000	$2,827,000	$3,287,000	$627,000	$127,000
Change in cost of power	.....	+$5,749	—$218,644	—$582,927	+$738,009	+$1,901,591	+$1,113,561	+$224,916	+$784,518	—$217,321
Per cent return on add. investment	.....	.....	4.75	10.38	.....	.....	.....	.....	.....	171.12

Chemical Equipment Buying Invites Installment Possibilities

By H. Bertram Lewis
Vice-President, Commercial Credit Company, Baltimore, Md.

THE FACT that installment merchandising has entered the field of industrial equipment will doubtless rate as news among chemical engineers and executives of the process industries. For years we have bought our motor cars installment-wise, likewise our radio sets, electrical refrigerators, washing machines and other domestic utilities of high unit value. The realization that the procedure which has made this possible is now being adapted to the sale of material-handling devices, loading appliances, pipe lines, evaporators, dehydration units, filters, temperature-control instruments, pumps, valves, condensers, mixing, crushing, grinding and pulverizing machinery, distilling apparatus and a score of other forms of plant equipment will be somewhat startling, perhaps, to operating men who have always associated the monthly payment principle with retail transactions.

Yet, after all, why not? The installment method has made its phenomenal headway in the domestic field on the strength of its two outstanding merits of (1) elasticity and (2) safety, and will certainly find a place in any other field of credit to which it can offer the same combination at a cost not incommensurate with its advantages.

Installment credit has never been the least expensive form of credit in any given market. It has been the most convenient, and, in some instances, the cheapest because of its convenience. To a high percentage of retail buyers it is the only available form of credit whereby they can afford to acquire classes of products. Its utilization in the industrial field has already been extensive enough to demonstrate that there also it is the most convenient form of credit for certain classes of transactions—the only form that makes some of them possible—and that its appeal to the buyer, because of its convenience, probably will be strong. In this field, though, its cost at times will be less than that of any other form of credit available for the financing in prospect. An instance of this kind will be cited further on.

TO DEMONSTRATE its possible value to the process industries, let us consider the optional sales plans available to the manufacturer who produces any of the equipment already mentioned or other types essential in the chemical engineering field. He may sell for cash or on open account, on a single maturity note or a series of them, unsecured except by the signer's responsibility. He may conceivably work out some sort of installment plan based on a title-retaining instrument which vests control of property in him until the last note has been paid—although, so far as can be ascertained, no workable finance plans of this kind are at present in existence.

It is obvious that this manufacturer will not expand his business very far on a straight cash basis, nor on an open-account basis with 30- to 90-day limits; nor yet on a single-maturity note basis unless one note or a series of them be made to cover what would be for him an inconvenient period of time. His cash business, furthermore, costs him discounts. His open-account business ties up a proportion of his working capital for 30 to 90 days. His notes can be carried in the safe or discounted at a bank. In the one case his working capital is curtailed. In the other, his bank lines are utilized, which may at times be inconvenient. If he were attempting to operate an installment plan of his own on an extensive scale he would be drawing heavily on his bank credit, setting up expensive and onerous credit and collection machinery, incurring special managerial burdens and risking losses due to inexpert methods.

BUYERS on the other hand, have the option of paying cash or buying on open account with a 30- to 90-day maturity, or on a single maturity note or a brief series of them. Until now they appear to have had no other options, except in isolated cases and in those of complete installation programs requiring large-scale financing. None of these except the last makes it possible to pay for new equipment out of earnings. None of them provides any way for the convenient financing of large units or multiple installations. Enter the finance company with terms of payment closely corresponding to a reasonable rate of amortization on the equipment. The manufacturer sells on this most attractive plan but gets his money at once. No discounts, no strained bank lines, no working capital tied up. A contingent liability—yes. But a basis of sale most alluring to the buyer, with features of protection for himself and with no drain whatever on his working capital or credit lines at bank.

The buyer, on his part, gets time enough to apply the direct earnings or savings of his new equipment to its purchase price, at a cost in keeping with the advantages of such an arrangement. In the case of a multiple installation involving a large outlay and otherwise necessitating a bond issue or other special financing he saves from every standpoint; witness an authentic case lately noted in our survey of this subject. A manufacturer of moderate size, in need of wholesale plant modernization negotiated a $500,000 bond issue for the purpose. It took him a year to arrange. He received 94 for his bonds and paid 6 per cent on the par valuation. He transferred to the underwriters 33⅓ per cent of his common stock. The bond issue ran for 25 years and entailed a total interest payment of $750,000.

If he had been able to negotiate an installment con-

tract at all to cover the transaction, the arrangements could have been made within a few weeks. The finance company itself could not afford to keep the matter open longer than that. Its credit appraisals come too numerously to permit such a delay. It must dispose of them as soon as all the facts can be accumulated. No common-stock transfer would have been involved. The contract would have terminated within the presumable active life of the equipment, and interest with it. The total carrying charges would have been but a minor fraction of the interest involved in the bond transaction. By the time re-modernization became necessary, in the natural course of events, the last detail of this transaction would have been concluded, the slate wiped clean, and the stage all set for new financing of any sort required.

IT IS important to note, in this connection, that we have been discussing two different applications of the installment method. The first is a conditional sale by the manufacturer of equipment to the user wherein the manufacturer assigns to a finance company the conditional sale agreement or equivalent instrument on which the sale is made and receives cash in return to the amount of the unpaid balance. The finance company handles all details from that point forward and, unless the buyer becomes delinquent, the manufacturer never hears of it again except for the receipt of a final payment notice. If the buyer defaults, the manufacturer generally is obligated, under a repurchase agreement, to refund the unpaid balance then outstanding to the finance company and thus assume responsibility for resale of the equipment.

The second application is a transaction between the finance company and the equipment user wherein the two—with the advice of competent engineering counsel—agree upon the equipment to be used, and the finance company buys the equipment and resells it to the user, retaining title to it by means of a chattel mortgage or such other instrument as meets the requirements of the case. The manufacturers of the chosen equipment have no voice in its selection. So far as they are concerned it is bought, not sold. The user, the consulting engineer and the finance company decide on it. If such financing should become at all general the finance companies might be found exercising a considerable influence on the equipment manufacturer's destinies. Unless, however, that manufacturer adopts an installment plan for the sale of his own product it will be the only method whereby the installment system can render its potential service to the process industries.

There are, of course, many considerations present in installment financing of industrial equipment which are not found in the sale of domestic utilities on installment terms. An equipment installation costing $10,000 ties up in one risk as much money as twenty average automobile installment sales and ties it up three times as long, if terms are made so as to permit the equipment to pay for itself. A $500,000 installation would require funds equivalent to a thousand automobile transactions and instead of having a spread which in itself is a virtual guarantee against heavy loss, the whole risk is concentrated in the fate of a single debtor, and its liquidation requires a much longer period of time.

On the other hand the finance company's acquisition cost of such large scale business is much less than that of an equivalent volume of automobile paper and the handling and collection costs are materially lower, so that if it pays out the finance company makes more money. The hazard, however, is incomparably greater, and if a loss occurs it is sure to be a heavy one. Therefore the responsibility of the buyer, and, in the case of business handled in the first instance by the manufacturer and protected by the latter's contingent liability, that of the seller, requires careful scrutiny and the application of such standards as a bank or group of underwriters would apply in appraising an equivalent industrial risk of any kind.

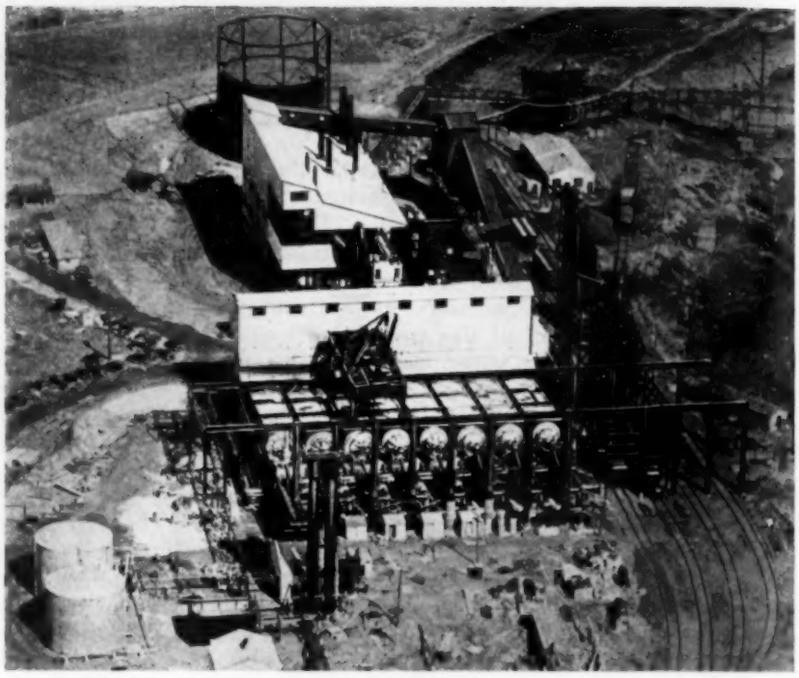
DEVISING a proper title-retaining instrument whereby the finance company preserves the right of repossession sometimes is a difficult legal achievement. And, even after this is done, there often remain practical questions to be settled to which a uniform answer has not yet been found. For example, in the recent case of a power-plant sale involving purchase by the finance company and refinancing to the user (a corporation), the only available title-retaining instrument, a chattel mortgage, required authorization by a stockholders' vote and the officers of the corporation considered it inexpedient to bring the stockholders into the matter. Purchase by the finance company, furthermore, would provide the user with no direct guarantee of performance from the manufacturer, and while such guarantee would run to the finance company, it is quite possible to conceive of a situation wherein the user and the manufacturer would differ diametrically on the interpretation of such guarantee and the finance company would be seated firmly and perilously in the middle of the resulting controversy.

These considerations probably are not insurmountable since legal and technical problems have beset the installment principle throughout the entire period of its evolution, and none of them has yet proved insoluble when the value of the business in sight demanded their circumvention. It is, nevertheless, important to realize that they exist and that each installment credit problem in the industrial field stands by itself and requires individual appraisal, factor by factor. The field is there; the installment system, where applicable, is ideal for the bridging of the credit gap that so often exists between the maker and the user of equipment. Its application is not yet an exact science, however, and perhaps never will be. In spite of which, those familiar with its possibilities fully expect to see it make effective headway in the industrial field as well as to preserve a sufficiently low loss ratio to make it thoroughly desirable from the finance company's standpoint.

Powdered Fuels for Engines

AFTER many trials and failures, a practical and reliable internal combustion engine appears to have been developed to utilize powdered coal as fuel. Unlike the Diesel engine, states Rudolph Pawlikowski in *Canadian Chemistry & Metallurgy*, it compresses air and fuel at the same time, but keeps them separated until the injection, after the compression. In the Diesel engine fuel oil must be atomized, heated and ignited in a small fraction of an engine stroke; the new engine allows a complete stroke for these operations. The engine has been successfully operated on dust of bituminous coal, lignite, peat, wood, charcoal, rice hulls, meal and coke. Ash disposal, of course, is one of the major problems; but in this engine the ash is so fine that the particles, even if they do get into the oil film, rub on only one of the metal surfaces, not on both. The exhaust is odorless.

New Brunswick plant of K.S.G. retorts begins large-scale operation and furnishes coal products from low-temperature processing to affiliated fuel and chemical companies



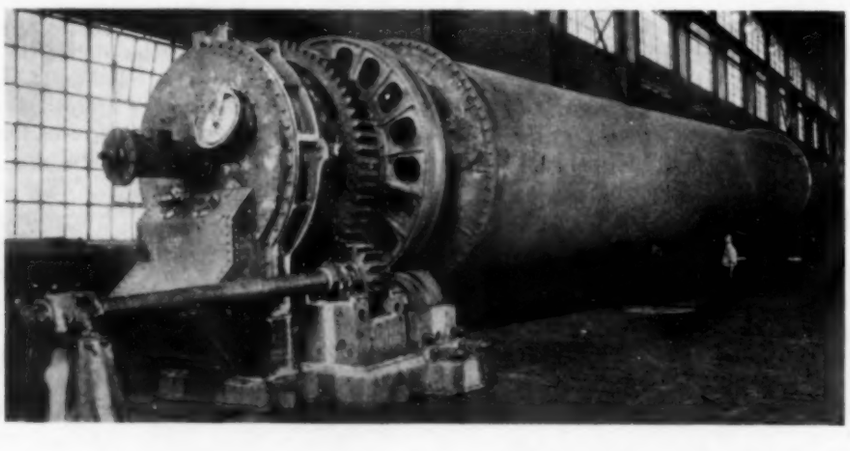
An Economic Test of Low-Temperature Coking

By R. S. McBride
Assistant Editor, Chem & Met.

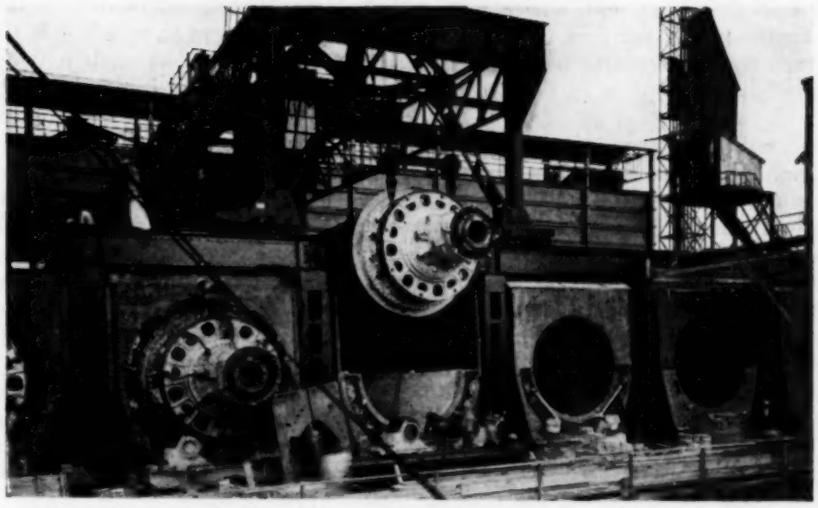
A THOROUGH TEST of the economic possibilities of low-temperature carbonization of bituminous coal under most favorable commercial conditions is assured by the erection and operation of eight K.S.G. retorts in the new plant of the New Jersey Coal & Tar Company at New Brunswick, N. J. This subsidiary of the International Combustion Engineering Corporation will have closely associated with it in the undertaking the other subsidiaries of the parent company which will handle the semi-coke for household fuel and the low-temperature tars and oils.

This interesting corporate set-up of closely affiliated companies recognizes clearly that balanced markets for all of the coal products must be maintained if profitable operation of the new enterprise is to be had. It recognizes the economic interdependence of the several projects and assures the minimum business difficulty in the interweaving of these new commodities with the present industrial fabric of chemical engineering industries. The composite of profits and deficits of the several affiliated concerns will, of course, represent the measure of economic success, all of which can be accurately measured by the parent company because of the close business association of the participating companies.

The K.S.G. process, named from Kohlenscheidungs-Gesellschaft—literally, Coal Separation Company—is



One of the Eight Retorts, Before Installation



Retort Being Placed in Refractory Setting During Construction of the Plant at New Brunswick

carried out in an externally heated rotary double-drum retort in two stages. Drying of the coal and preheating to a point just below its softening temperature takes place in the first stage in the inner drum of the retort. Very precise control of temperatures during this preheating is required; first, in order that there may be no development of plastic masses in the inner shell because of too high a temperature, and second, so that the coal will be preheated up to the point that it will quickly carbonize when discharged into the outer shell, a result not obtained if the temperature attained during preheating is too low.

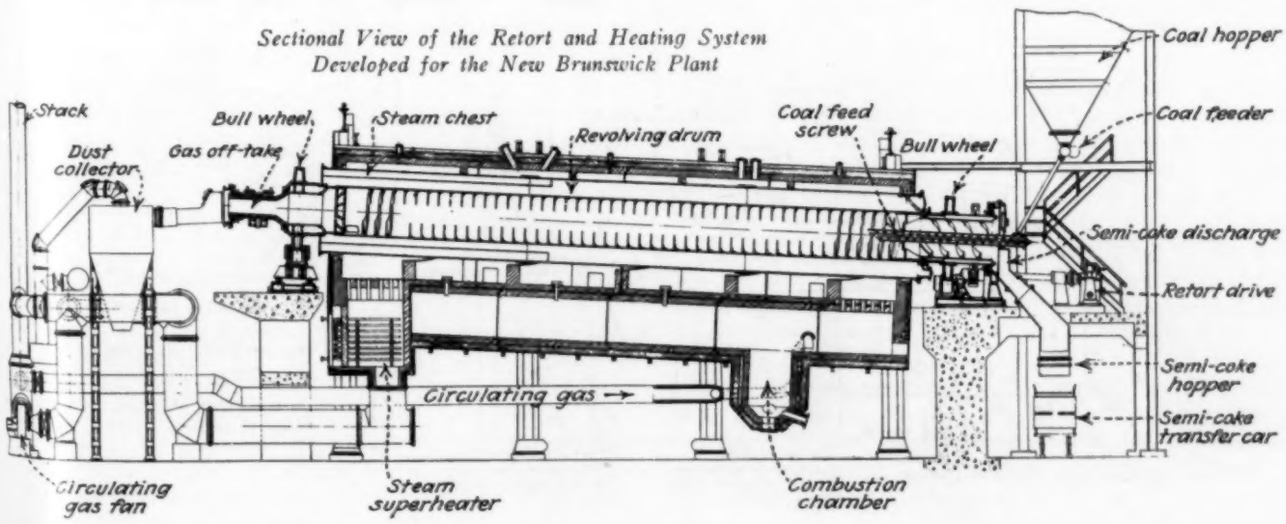
The behavior of the coal while plastic during early stages of the coking in the outer shell determines the size, density and burning characteristics of the semi-coke made. No single operating procedure can be adopted by all such plants, because the optimum conditions of temperature, time and heat distribution vary from coal to coal. In general, however, the object is to have as large as possible a percentage of the solid residue from the coal appear as lump-size rugged pieces of semi-coke suitable for household furnace use. To the extent that this result can be achieved the process will improve its financial prospects, because the largest portion of income necessarily must be derived from the marketing of the household fuel.

For five years the K.S.G. process has been in commercial-scale operation near Essen in Germany. The New Brunswick plant represents, therefore, an adaptation to American conditions of a coal-processing scheme which has had thorough technologic trial elsewhere. The adaptation to American conditions has been carefully considered so that truly best American practice should be introduced for each feature of design and operation. The only portion of the plant which retains substantially the original German design is the retort and retort setting, and even here American methods of fabrication and American materials have been used exclusively. To have changed the design radically on the retort or its setting would, it appears, have introduced new uncertainties in plant performance not warranted until thorough trial could be given to economic considerations prevailing in this country by actually making and marketing the new types of products here.

Reference to the sectional drawing of the K.S.G. retort will reveal many of its constructional details. This retort, consisting of two concentric externally heated drums, is rotated 45 revolutions per hour on bull rings at each end which support it at an angle of 5 deg. to horizontal. The inner drum, 85x5.5 ft., is made of $1\frac{3}{16}$-in. open-hearth steel plate with hammer-welded seams reinforced on circumferential welds; the outer drum, 72x10 ft., of $\frac{7}{8}$- and 1-in. plate, is similarly fabricated. The complete retort weighs 160 tons.

Crushed coal is fed continuously into the inner drum, through which it is moved by helical flanges to the higher end, where it drops through open ports to the outer drum, where it becomes plastic. The coal is carbonized

Sectional View of the Retort and Heating System Developed for the New Brunswick Plant



during its passage to the lower end, where it is picked up as semi-coke containing 12 per cent volatile matter by helical scoops which feed the reverse helical flanges that carry it to the discharge. Coal is in the retort a total of two hours.

Heating is done with two proportioning burners that admit producer gas and air in equivalent quantities for theretical combustion, producing 2,500 deg. F. in the combustion chamber. Stack gas is returned by a recirculating fan to mix with the hot products of combustion in such proportion as to maintain 1,200 deg. F. in the first pass about the retort. Heating gas follows a helical path upward about the retort with addition of more hot combustion products in each pass to provide the desired temperature distribution along the retort and attain a maximum temperature of 1,350 deg. F. in the last upper pass. The gross heat used in carbonization is about 800 B.t.u. per pound of coal.

The products of combustion leaving the heating flues at the upper end of the retort pass first over the alloy-steel tubular steam superheater, which raises 100 to 200 lb. of exhaust steam per ton of coal to 900 deg. F. for use inside the retort, where the steam serves to restrain tar cracking and to prevent sticking of plastic coal to the retort wall. The products pass from the superheater outlet around the dust catcher, to prevent condensing of tar in this unit, and thence to the stack.

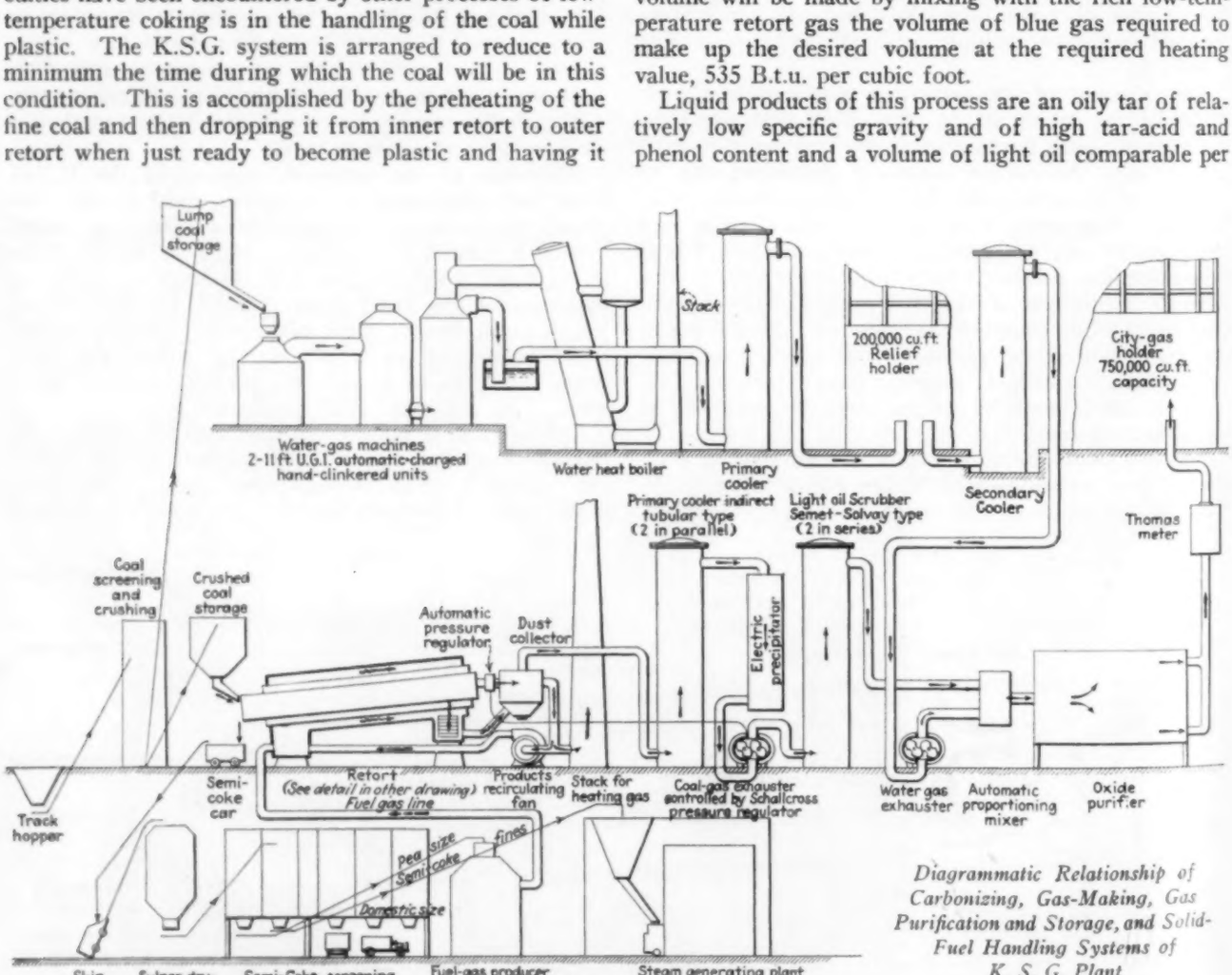
One of the principal points at which technical difficulties have been encountered by other processes of low-temperature coking is in the handling of the coal while plastic. The K.S.G. system is arranged to reduce to a minimum the time during which the coal will be in this condition. This is accomplished by the preheating of the fine coal and then dropping it from inner retort to outer retort when just ready to become plastic and having it immediately encounter in the outer retort the highest temperatures to which it is to be subjected.

Prevention of carbon deposits on the retort wall at this point is, of course, vital. This is effected in part by quick heating and by introducing steam tangentially along the upper one-third of the length of the shell to form a vapor screen between the softened coal particles and the metal wall. To remove any carbon that does adhere, chains stretched longitudinally in this upper section of the outer retort drag upon the shell and mechanically loosen deposited carbon so that it will pass on through the retort with the coke. Five years' operation at Essen have demonstrated the complete effectiveness of this system.

Disposal of semi-coke too small for household fuel is assured at the New Brunswick plant by the use of the pea size for the generation of producer gas, which is used in underfiring of the retorts, and by burning of the fines or breeze for boiler firing. The plant is so arranged, however, that if it becomes profitable to work up into marketable form this small-size semi-coke this can be done and the underfiring gas and process steam then will both be made from coal.

This scheme insures that all of the rich coal gas will be available for sale; and this plant has an arrangement with the Public Service Electric & Gas Corporation of New Jersey to take a minimum of three million cubic feet per day of gas to be used in city supply. This large volume will be made by mixing with the rich low-temperature retort gas the volume of blue gas required to make up the desired volume at the required heating value, 535 B.t.u. per cubic foot.

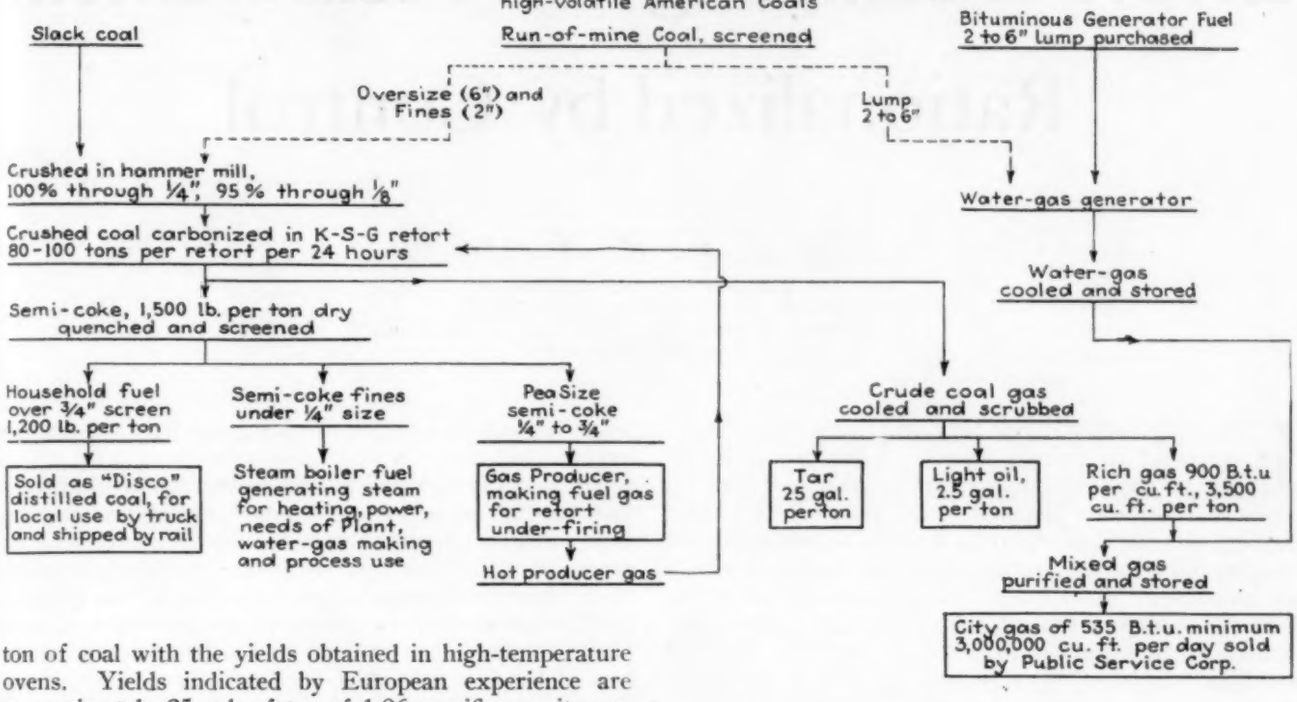
Liquid products of this process are an oily tar of relatively low specific gravity and of high tar-acid and phenol content and a volume of light oil comparable per



Diagrammatic Relationship of Carbonizing, Gas-Making, Gas Purification and Storage, and Solid-Fuel Handling Systems of K. S. G. Plant

Material Flow in the New Brunswick Plant

Quantities indicate estimated capacity operation with typical high-volatile American Coals


Slack coal
Run-of-mine Coal, screened
Bituminous Generator Fuel 2 to 6" lump purchased
Oversize (6") and Fines (2")
Lump 2 to 6"
Crushed in hammer mill, 100% through ¼", 95% through ⅛"
Water-gas generator
Crushed coal carbonized in K-S-G retort 80-100 tons per retort per 24 hours
Water-gas cooled and stored
Semi-coke, 1,500 lb. per ton dry quenched and screened
Household fuel over ¾" screen 1,200 lb. per ton
Semi-coke fines under ¼" size
Pea Size semi-coke ¼" to ¾"
Crude coal gas cooled and scrubbed
Sold as "Disco" distilled coal, for local use by truck and shipped by rail
Steam boiler fuel generating steam for heating, power, needs of Plant, water-gas making and process use
Gas Producer, making fuel gas for retort under-firing
Tar 25 gal. per ton
Light oil, 2.5 gal. per ton
Rich gas 900 B.t.u per cu. ft., 3,500 cu. ft. per ton
Hot producer gas
Mixed gas purified and stored
City gas of 535 B.t.u. minimum 3,000,000 cu. ft. per day sold by Public Service Corp.

ton of coal with the yields obtained in high-temperature ovens. Yields indicated by European experience are approximately 25 gal. of tar of 1.06 specific gravity per net ton of good-quality high-volatile coal. Although no precise operating figures are yet available from New Brunswick, because of the short time that this plant has been functioning, the results being obtained there indicate that the European experience will be duplicated closely, both as to yield and chemical characteristic of tars and oils formed.

These liquid products of carbonization will all be shipped from the New Brunswick plant to the Newark works of the International Combustion Tar & Chemical Corporation, a closely affiliated concern. Because of the high percentage of creosote oil in the tar and its high content of phenols, the tar can be credited to the carbonization plant at a price in excess of the current market value for high-temperature tar. The high light-oil content of the tar insures five gallons of this product per ton of coal processed, about half being recovered at the carbonization plant as light oil and the other half being found in the tar. This light oil has been found to contain constituents of very high anti-knock value. Hence the motor benzol including these constituents promises to command at least a small bonus in the market over prices prevailing for light oil made at high-temperature plants.

As compared with high-temperature carbonization products there is recovered at New Brunswick per ton of coal more than five times the volume of phenols suitable for use in synthetic resin manufacture. The companies interested in this enterprise have recognized the large economic significance of this fact and are engaged upon an extended research program with a view to making plastics on a large scale. Their effort is being directed toward the types of plastics for which there exists a growing market.

The tar products group also is concerning itself actively with the markets for tar coke (pitch coke), pitch and the other principal heavy products of tar refining. This group points out, however, that the large yield of liquid products is made up primarily by increases in the tar acids, the creosote oil and very light tar products for which ample market exists; the yield of pitch or pitch coke per ton of coal processed is, therefore, substantially no greater than in high-temperature ovens.

Future prospects for the K.S.G. process apparently rest primarily upon the ability of its backers to secure at the requisite price an adequate outlet for the semi-coke as a household fuel. There is no question as to the adequacy of the present and readily accessible markets for gas, light oil and most of the major tar products. The aggregate financial return from these markets, of course, will depend largely upon the degree of success attained in the making and advantageous marketing of those new tar derivatives peculiar to low-temperature tars, including secondary products such as plastics. However, any tar products which do not find ready market elsewhere can always be promptly marketed in competition with other liquid fuels.

Because of the low temperature prevailing in the retort a negligible quantity of ammonia is made in this process; hence the nitrogen situation of the country is unaffected by the development and is of no concern to the owners of K.S.G. plants.

Semi-coke of the type made in this plant appears to have very desirable burning characteristics. Successful marketing for household use, therefore, will depend upon the ability to make a reasonably rugged product in pieces of acceptable size and, of course, upon the price which must be charged in competition with other solid fuels, particularly anthracite. If a satisfactory semi-coke market can be developed and maintained on a suitable price basis, the economic as well as the technical success of the process seems assured. And with that success in the preparation of manufactured fuel will automatically come further advancement in the making of chemical raw materials from coal. This has large significance for the chemical engineering industries, even though only 12 per cent of the weight of the coal used will appear as such industrial raw materials.

Errors of Sampling and Measurement Rationalized by Control

By A. E. R. Westman

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University of Illinois)

ENGINEERING tests very frequently have results reported in average values. These are more accurate than individual values but this fact does not alone warrant their unqualified acceptance. It is customary, therefore, in reporting a series of measurements to give not only the average value but also an estimate of its average deviation or of its standard deviation. The standard deviation of the average gives the range within which about 68 per cent of similarly obtained averages may be expected to fall. It is to be preferred to the average deviation for several reasons, the most important from the engineering standpoint being in the number of specimens, since the use of 100 is equivalent to 114 in the case of average deviations—a desirable economy of time and effort.

The usefulness of average values depending on their precision, an engineer should be able to plan and execute tests in such a way that the standard deviations of the average values are small. This presupposes a knowledge of the factors which govern the accuracy of an average and their relative importance.

In addition to constant and systematic errors, averages are subject to two important sources of error, namely, measurement and sampling. (Constant errors tend to make all values too high or too low by a constant amount. Systematic errors depend on the magnitude of the values or on uncontrolled factors which vary systematically; constant errors are minimized by calibration and standardization, systematic errors by corrections or the use of comparative methods.) In determining the average strength of a brand of bricks by tests of individual bricks, errors of measurement are made in determining the strength of a single brick and depend on the accuracy of the method, the precision of the apparatus, and the skill of the observer; errors of sampling are caused by variation in strength from brick to brick and the use of an average based on tests of a few bricks to characterize a whole brand.

ATTEMPTS to increase the accuracy of an average by reducing errors of measurement are often unsuccessful or secure results which could be obtained more economically by a reduction of sampling errors. Estimates of the number of specimens needed in an engineering investigation can be made systematically from preliminary experiments or previous data when the relation between errors of sampling and measurement is understood. It is the purpose of this paper to present charts which can be used in solving systematically the problems involving errors of sampling and measurement which arise in connection with engineering tests and to explain their use.

Most of the factors involved in the following discussion can be expressed as standard deviations and are designated by the symbol σ, with suitable subscripts. In practically all engineering tests, the standard deviation of an observed average value, designated by σ_A, depends on (1) the inherent variability of the materials or population under test, expressed by σ_T, the standard deviation of the *true* individual values or those which would be obtained when errors of measurement were absent; (2) errors of measurement of a typical, observed, individual value, expressed by σ_E, the standard deviation of repeated measurements on the same specimen; and (3) sampling errors, which depend on n, the number of specimens in the sample. The standard deviation of the average, σ_A, is calculated from σ_O, the estimated standard deviation of the observed individual values, by dividing by $\sqrt{n}$. (When n, the number of specimens in a sample, is small, the small sample theory should be used in estimating σ_O.)

INHERENT variability of a material under test and, consequently σ_T, cannot be changed by the investigator and are constant for any particular case. Hence, simplification without loss in generality can be secured by expressing σ_A and σ_E in terms of σ_T. If, in addition, usual statistical assumptions and methods are used, the relation:

$$n = (1 + \sigma_E^2)/\sigma_A^2 \qquad (1)$$

can be derived, in which σ_E is the standard deviation of measurement and σ_A is the standard deviation of the average; σ_E and σ_A being expressed in units of σ_T. (Cf. *J. Am. Ceram. Soc.*, Vol. 11, No. 4, pages 264-270.)

The chart in Fig. 1, then, is based on equation (1) and gives the relationship between n, the number of specimens in a sample, and σ_E, the standard deviation of measurement, for selected values of σ_A, the standard deviation of the average value obtained by measurements of the sample. Both σ_A and σ_E are expressed in terms of σ_T. The chart covers the field of testing in which samples of from one to 120 specimens are used, errors of measurement are less than ten times the variability of the materials tested and the error of the average ranges from one-tenth to five times this variability. Most engineering tests are included in this field.

What is essentially an enlargement of the lower part of Fig. 1 is given in Fig. 2; this permits accurate calculation for samples of less than 30 specimens. It was

prepared by dividing the n scale in Fig. 1 by four and doubling the σ_A values on the curves.

The following example will show how the charts should to be determined with a standard deviation, σ_A, of ± 1.0. Repeated measurements of one specimen show that σ_E is equal to ± 2.5. The standard deviation of the true porosities of the bricks, σ_T, equals ± 5.0. How many specimens should be tested?

In terms of σ_T, σ_A and σ_E are equal to 0.2 and 0.5 respectively. The junction of the curve for $\sigma_A = 0.2$ and the ordinate for $\sigma_E = 0.5$ in Fig. 1 gives $n = 31$. Therefore, at least 31 specimens should be used.

An examination of the general shape and position of the curves in the charts leads to some interesting qualitative conclusions. The spacing of the curves along the perpendicular axis, for example, shows that, for $\sigma_A < \sigma_T$, n must be greater than unity, even when errors of measurement are absent, and increases rapidly as σ_A decreases. In other words, when the accuracy desired is greater than the uniformity of the material, sampling errors are very important and cannot be overcome by increasing the accuracy of measurement.

For $\sigma_A > \sigma_T$, one specimen may be enough if σ_E is very small. However, since a large increase in σ_E is readily offset by an increase in n, it will be more economical usually to use several specimens, especially if σ_E is smaller than σ_T. In other words, if the desired accuracy is less than the uniformity of the material under test, accurate measurement of small samples will suffice but less accurate measurement of larger samples will generally be more significant and economical. If the errors of measurement are much larger than the desired error of the average, the reverse is true.

IN PLANNING an investigation, estimates of σ_E and σ_T usually must be made before the charts can be used to determine proper sizes for samples. Such estimates may be based on previous tests of similar materials or on preliminary tests.

Estimates of σ_E for a particular method and apparatus can be formed from the results of repeated measurements of one specimen or series of duplicate or triplicate tests of several specimens. When repeated measure-

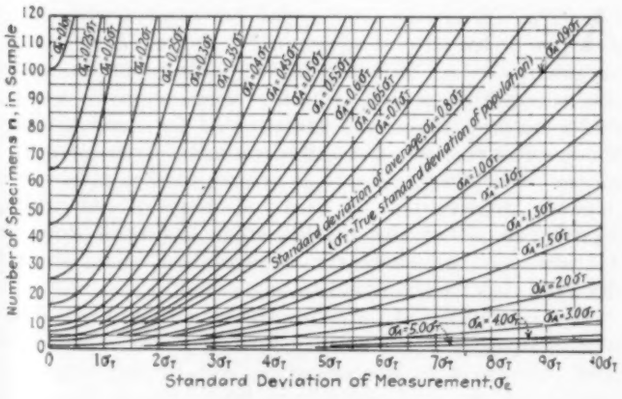

Fig. 1—Relationship of number of specimens and standard deviation according to Equation 1

ments are impossible, as in crushing tests, tests of a very uniform material or the application of the theory of propagation of errors will enable estimates to be made. When each specimen is itself a group of individuals, σ_E can be calculated easily.

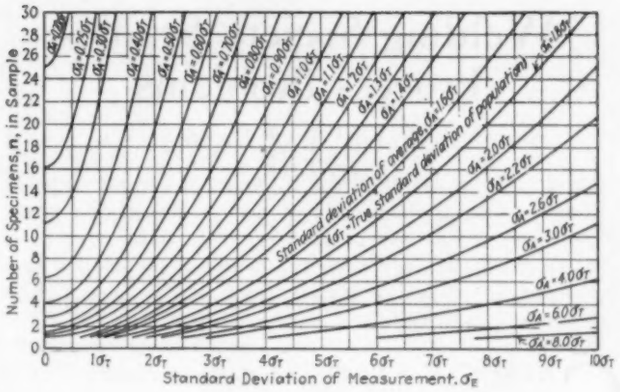

Fig. 2—Enlarged Diagram for Calculation of Smaller Groups

The standard deviation, σ_T, for the true test values of the individuals forming the group, brand or population under consideration can be estimated from tests in which σ_E is known or is very small, the equation:

$$\sigma_T = \sqrt{\sigma_O^2 - \sigma_E^2} \qquad (2)$$

being used. Engineering research would be greatly benefited if values of σ_T for important materials were determined and tabulated. In most of the above methods of estimation, good use can be made of the small-sample theory of "Student" and Pearson; formulas and charts are given by Shewhart, *Bell System Technical Journal*, Vol. 5, No. 2, pages 308-19 (1926).

BY WAY of illustration, the following examples may serve to show further how the quantities are to be applied in practice. The strengths of fifteen bricks of a certain brand had an average value whose standard deviation, σ_A, was estimated to be ± 49 lb. per sq.in. An average value with a standard deviation of ± 23 lb. per sq.in. was required. Should more bricks be tested or a more accurate apparatus be developed?

Application of the least squares formula for the propagation of errors gave an estimate of σ_E^2 of 40.5 lb. per sq.in. From equation (2) σ_T was estimated to be 191 lb. per sq.in. Expressed in terms of σ_T, therefore, σ_A and σ_E had values of 0.126 and 0.030 respectively. For these values, Fig. 1 gave $n = 64$ and showed that practically no advantage would be secured by increasing the accuracy of the apparatus, *i.e.* by decreasing σ_E. Tests of 64 bricks were therefore required.

To illustrate further, in comparing methods of manufacture, the average strength of stiff-mud brands of brick is required, σ_A to be approximately ± 50 lb. per sq.in. How many bricks and how many brands should be tested, the strengths of fifteen bricks of each of eight brands being known?

The standard deviation of the average of fifteen bricks of a typical brand is found from Shewhart's Chart to be ± 48 lbs. per sq.in. Assigning this value to σ_E and proceeding as in the previous example, the desired σ_A and actual σ_E in terms of σ_T are found to be 0.147 and 0.14 respectively. For this value of σ_E, Fig. 1 shows that 46 brands or 690 bricks should be tested and that, if a slightly larger number of brands are tested, σ_E can be increased considerably, i.e., fewer bricks of each brand need be used. With 48 brands, only 4 bricks of each brand are required or a total of 192 bricks, and much labor can be saved.

Welding Society Studies Process Problems

Editorial Staff Report

EDITOR'S NOTE—*Welding is a chemical engineering tool that is being applied daily in more practical and profitable uses. The symposium reported here stresses its application not only with the common metals but with the special alloys so widely used in the chemical engineering industries.*

CHEMICAL ENGINEERS are becoming "welding-minded" not only through their own efforts but through the organized work of the welding profession. Thus at the annual meeting of the American Welding Society held in New York April 24-6 an outstanding feature was a symposium on "Welding in the Chemical and Process Industries," presided over by E. A. Doyle, consulting engineer. Five papers discussed welding practice not only as applied to iron and steel but to aluminum, nickel, Monel and Duriron. Particular attention was paid to the peculiar requirements of the chemical industry for resistance to corrosion and similar conditions of severe service.

Some time ago W. M. Dunlap, of the Aluminum Company of America, prepared an exhaustive paper on the welding of aluminum and its alloys. This was published in the January, 1929, number of the *Journal of the American Welding Society* and at this meeting Mr. Dunlap presented the subject only in brief abstract, emphasizing particularly the comparative strength tests on welded commercially pure aluminum pipe and the original unwelded material. His summary table of tensile tests showed that there is practically no difference between the tensile strength of the welded tubes and the unwelded. Of a total of eighteen welded samples but two failed in the welds—indicating that the weld was actually stronger than the original tube.

A summary table of hydrostatic tests showed practically the same strength for both the welded and the original samples. In these tests none of the failures occurred at the welds, for in every case the pipe burst between the weld and the end of the sample. The building up at the weld apparently had the effect of a stiffening rib around the tube. The reader is referred to Mr. Dunlap's article for the details of these tests as well as the actual methods and welding procedure employed.

Despite the common textbook assertions that nickel is unweldable by fusion methods, N. B. Pilling and T. E. Kihlgren, of the International Nickel Company, showed that both nickel and Monel metal are excellently adapted for fabrication by fusion welding. The production of welds which are strong, sound and ductile requires adherence to suitable methods of welding rather than to the exercise of unusual manual skill.

OF THE arc methods the carbon arc is preferred because it yields a weld metal superior in strength and soundness to that laid down by the metallic arc. Welds of excellent quality can be produced by the acetylene flame provided the fluxing conditions are controlled. An ingenious and convenient method is to impart a mild but controlled fluxing action to the flame itself by introducing a gaseous boron compound (ethyl borate) into the acetylene supply.

Alan G. Wikoff, of the Carbide & Carbon Corporation, cited evidence that welding has become a part of nearly every construction program in the chemical engineering industries. Much equipment is purchased on a welding specification and when constructed within the plant, welding is used because it offers unusual convenience and increased safety. With the help of many excellent slides, Mr. Wikoff showed how welding was actually applied in the new construction of a large chemical plant in which unusual problems of gas handling and processing were met. He also showed that welding had an equally important application in removing obsolete equipment and the remodeling of old processes.

A number of plants have found that the semi-works scale and experimental operations offer one of the best opportunities to give oxyacetylene welding a trial in equipment construction. It introduces a flexibility not possible with other types of construction.

Prof. T. McLean Jasper, of the A. O. Smith Corporation, discussed the welding of pressure vessels for high temperatures and pressures using the patented autogenous method of the A. O. Smith Corporation, which was described by N. W. Krase in *Chem. & Met.*, for November, 1928, pages 661-7. In all, this company has built more than a thousand pressure vessels for oil cracking, ranging in size up to 396,000 lb. and 10 ft. in diameter. Strong ductile joints are required of no greater thickness than the metal itself since thickness of joints by overlapping greatly increases the stress on the adjacent metal. This is most pronounced in thick-walled pressure vessels. It is significant that by the use of welding equivalent vessels can be made with but 70 per cent of the metal required if riveting is used and in addition there is an increase in safety.

Professor Jasper told of certain cracking chambers which had recently been tested to destruction after 3½ years of severe service. One, which was properly designed and reinforced, burst at well over 100 per cent of the minimum strength of the steel itself. The other, without the reinforcing, failed at 61 per cent but in neither case at the welded seams. Due to corrosion the walls of these vessels had been reduced from 2½ in. in thickness to 1.6 in., and in each case the plate metal had corroded more than the welds.

A PAPER on the welding of Duriron had been prepared for the symposium by Peirce D. Schenck, president of the Duriron company. He pointed out that the successful welding of this alloy requires a clear understanding of the characteristics of the metal although the procedure does not differ radically from that employed in welding gray iron. Care required in pre-heating depends largely upon the size and shape of the casting. Practically all of the welding that has been done on Duriron has been with the oxyacetylene flame since it does not oxidize the metal to any extent.

Welding is largely used in the manufacture of Duriron equipment in the factory as well as for repair work and alterations to equipment in use in the plant. A number of chemical works have been welding this material for many years in order to salvage expensive equipment or to build up special pipe layouts for heating coils, condensers and similar equipment. Mr. Schenck referred to the natural question as to the effect of welding on the acid resistance of Duriron. There is, of course, a slight difference in structure between the original metal and the weld but since the weld usually contains slightly denser metal than the original casting it is actually affected less by corrosion.

Convenient Chlorine Carrier Supplied by New Product

By R. E. Gage

Chief Chemical Engineer
Mathieson Alkali Works, Inc.

CONVENIENT application of chlorine for many operations has not always been possible in the past either with bleaching powder or even with liquid chlorine itself. Many industrial users of chlorine, especially those requiring relatively small quantities, object to the use of liquid chlorine on account of the difficulties and inconvenience involved in the shipping and handling of the heavy steel containers. Such objection goes even to the extreme that in some cases the workmen regard chlorine as a poison gas and any compressed gas cylinder as a potential high explosive. These objections to liquid chlorine are, of course, soon overcome in the case of workmen once accustomed to handling chlorine, but they may remain a factor affecting the morale of other employees who are not directly concerned with the handling.

The use of bleaching powder has been even less satisfactory in many industrial applications, principally because it is unstable and hence of variable composition and so cannot be depended upon to yield hypochlorite solutions of uniform strength for a given weight of material. In true calcium hypochlorite, now commercially available, a convenient chlorine carrier is offered which is free from the objections noted and which holds interesting possibilities for extensive industrial application.

THE usual measure of the industrial value of hypochlorites is the content of so-called "available chlorine." This term is understood by chemists to refer to the oxidizing value of the product and not to the actual amount of the element chlorine which it contains. The true significance of the term is little understood by the consuming trade, but its use is firmly established and will be adopted as a basis of comparison in the present article.

Bleaching powder, although often erroneously referred to as calcium hypochlorite, is actually quite a different chemical compound. Its exact structural composition has been a subject of considerable controversy. Undoubtedly its composition is variable according to varying conditions of manufacture, but it has been proved that the chief constituent of commercial bleaching powder is a complex molecular compound, the formula of which is probably of the type indicated by Ditz, $CaO \cdot CaCl(OCl) \cdot H_2O$. Commercial bleaching powder may range in composition anywhere from zero to 40 per cent "available chlorine." Only the chlorine linked with oxygen in the hypochlorite group (OCl) is "available" for the oxidation reactions involved in the familiar uses of bleaching powder.

True calcium hypochlorite, $Ca(OCl)_2$, has until recent years existed merely as an ideal symbolized by a formula in the textbooks. It is a highly concentrated chlorine carrier as the formula indicates. Chemically pure calcium hypochlorite would contain nearly 100 per cent "available chlorine," and would thus, pound for pound, be chemically equal to liquid chlorine for all bleaching or oxidizing reactions.

Pioneer work in the development of processes for the manufacture of high-test calcium hypochlorite has been carried on in Germany during the last twenty years particularly by Pistor, Schultze, and Reitz, all associated with the Griesheim-Elektron, now a part of the I.G. This concern has been in rather limited commercial production of such a product for several years and has offered it to the export trade in South America and in the Orient; but no appreciable commercial quantities have so far been offered in the United States or in Europe.

The Mathieson Alkali Works initiated independent research on high-test hypochlorite about eight years ago. This work has resulted in the successful development of a new manufacturing process radically different from that used in Germany. By this process a high-test calcium hypochlorite is now being made in commercial quantities at the company's plant in Niagara Falls, New York. The details of this process, covered by patents now pending in all leading countries, will be described in forthcoming articles.

The fundamental research leading up to the development of several possible new processes for the manufacture of hypochlorites has been carried out by M. C. Taylor, chief research chemist of the Mathieson Alkali

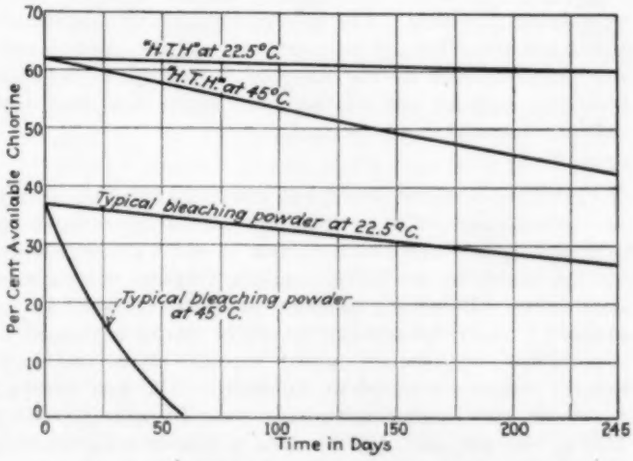

Fig. 1—Comparative Stability of High-Test Hypochlorite and Bleaching Powder

Works, and R. B. MacMullin—together with their former associates J. A. Guyer and Anthony George. The pioneer phase equilibrium study which led directly to the process finally adopted is principally the work of R. B. MacMullin and constitutes a notable achievement in the chemistry of hypochlorites. Scientific articles covering the various phases of the work of these investigators will shortly be published. The present article is limited to a summarized presentation of the properties of the new product in order to indicate or suggest its unique adaptability to many industrial uses.

IT IS impractical to make chemically pure calcium hypochlorite at a reasonable cost. Products containing 80 to 85 per cent $Ca(OCl)_2$ have been made in the laboratory on a semi-commercial scale but are too expensive to compete commercially with bleaching powder and liquid chlorine. In the new commercial product it has been decided to offer initially a product containing "available chlorine" in the range of 60 to 65 per cent, which under present conditions is the product affording the maximum amount of available chlorine per unit of cost. This is now being marketed under the trade name "H T H"—a convenient commercial contraction of the phrase "high-test hypochlorite."

The possibilities of high-test hypochlorite are most readily indicated by contrasting it with ordinary bleaching powder. This latter material is typically very unstable and consequently of widely variable composition, even if properly made. Furthermore, poor control of manufacturing conditions may result in wide differences in composition of the product when fresh. Inevitably bleaching powder is hygroscopic, largely because of the contained calcium chloride; and its decomposition is greatly accelerated by increasing temperature. It must, therefore, be stored with great care or it soon becomes worthless, especially under summer or tropical conditions. The same constituent of bleaching powder accounts for its caking, which always occurs unless stored out of contact with moist air.

In the nature of things no hypochlorite can be absolutely stable and invariable in composition under all conditions. Obviously if such were the case its chlorine would not be "available." The ideal hypochlorite in this respect would of course be one which readily exerts its oxidizing effect under conditions of industrial use, but which remains unaffected under ordinary conditions of storage. Bleaching powder falls far short of this ideal. High-test calcium hypochlorite much more closely approaches the ideal. The accompanying chart illustrates strikingly the effect of temperature and the corresponding chlorine loss in the case of a typical high-grade bleaching powder and of the more stable new high-test calcium hypochlorite now available.

IT WILL be noted from this chart that the advantage in stability of the new product is appreciable at ordinary room temperatures, but is even greater when storage must be maintained under tropical or summer conditions. Bleaching powder is quite variable in its stability; many commercial products would be found to decompose very much more rapidly than the high quality sample indicated in the chart. The new product possesses the further advantage over bleaching powder that it will not cake but remains a free-flowing powder under all ordinary conditions of storage.

Table I gives comparative analyses of a typical bleaching powder of the best grade and of the commercial high-test calcium hypochlorite.

Table I—Comparative Analyses of Bleaching Powder and High-Test Hypochlorites

	Typical Bleaching Powder, Per Cent	Calcium Hypochlorite, Per Cent
Available chlorine	36.0	63.0
Calcium chloride	28.5	0.5
Free lime	13.0	3.5
Inert constituents	6.5	31.5
Water	16.0	1.5

The apparent density of the calcium hypochlorite may be varied by proper control of the manufacturing process; products having apparent densities from 0.5 to 1.2 have been made. The absolute density of the commercial product is 2.2 to 2.35 and is very nearly constant regardless of variation in apparent density.

Sodium hypochlorite solutions are often preferred for many industrial uses in which the presence of calcium salts in appreciable amounts is considered objectionable. The high-test calcium hypochlorite offers a convenient means for the preparation of solutions of sodium hypochlorite by the simple addition of a sodium compound which causes precipitation of an insoluble calcium salt. Sodium carbonate is usually used for the purpose. The preparation of such a solution is extremely simple, for example: The contents of the standard can (about 4 lb., equivalent to 2½ lb. "available chlorine") is dissolved in 5 gal. of cold water and stirred for a few minutes; 3 lb. of soda ash is then added directly to the solution and stirring continued a few minutes longer; water is then added to obtain the proper dilution desired, e.g., 25 gal. to give 1 per cent available chlorine solution; after about 30 minutes settling the sodium hypochlorite solution may be drawn off and is then ready for use.

PROPERTIES which distinguish high-test calcium hypochlorite and which render it particularly dependable and convenient as a source of "available chlorine" may be briefly summarized as follows:

1. Stability; an unusually stable hypochlorite compound. Can be stored with a minimum of loss in strength even under tropical conditions.
2. Uniformity; of practically uniform composition which because of accurate manufacturing control and of high stability, retains its initial composition over long periods.
3. Concentration; uniformly high content of "available chlorine," averaging better than 62 per cent at time of manufacture.
4. Solubility; dissolves readily in cold water, giving substantially all its "available chlorine" in solution with a relatively small amount of quick-settling insoluble matter.
5. Non-deliquescence; remains a free-flowing powder under all ordinary atmospheric conditions, thus making it convenient of application and free from the problems of caking and deliquescence.

The wide industrial usefulness of a hypochlorite having these properties insures for the new product a substantial and growing market. It will at once find application for industrial operations already established, such as textile bleaching, laundry sterilizing and bleaching, pulp bleaching, dairy disinfecting and bottle sterilizing, and for the chlorination of swimming pools and for isolated water supplies. It may also be predicted with confidence that new industrial and manufacturing uses for such a product are bound to develop.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Priority in the Matter of Chemical Periodicals

EDITOR'S NOTE—In an article in our March issue entitled "How a Little Periodical Serves a Consultant's Public" the author, Arthur R. Maas, of Los Angeles, stated that the original suggestion for his publication, *Chemistry & You*, came from the *Industrial Bulletin* of Arthur D. Little, Inc. It now appears that Mr. Maas unintentionally confused the latter publication with *Business Chemistry*, published by Skinner, Sherman & Esselen, Inc. The first issue of the *Industrial Bulletin* did not appear until three years after the publication of the Maas laboratories was first issued, and four years after the publishing of the Skinner, Sherman & Esselen periodical. In a letter to the editor, Mr. Maas states: "*Business Chemistry* should have had the credit in my article and I am sorry that this confusion has arisen between the two excellent chemical publications of Boston, which in this matter is truly the hub of the chemical universe."

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Feasibility of Jet and Spray Electroplating

To the Editor of Chem. & Met.:

Sir:—An idea which has occupied the writer for some time is offered here in the hope of evoking some criticism and intelligent comment. Presumably neither jet nor spray electroplating has been suggested before; but, although the writer confesses to not having tested them experimentally, he feels that they hold some promise. However, he has secured opinions from various well-qualified scientists and has found them very conflicting, especially on the spray method.

The jet idea is simply to suspend the article to be plated above the bath, and to have jets of the electrolyte, pumped from near the anode, play upon the article. In the completed device these jets are supposed to be adjustable, in both diameter and position, so than an object of any shape whatever to be plated can be subjected at every point on its inside and outside surface to a uniform feed of plating material. The opinion of the writer is that such a device would increase vastly the speed of plating, and would at the same time secure a uniform coating, or, in fact, any differential in coating desired for the different parts. Presumably the anode would be in the form of a wire brush.

The spray idea is, confessedly, somewhat more abstruse in theory. However, the idea simply stated is to suspend the article as before completely above the bath, to have the entire bath enclosed, and to spray from the vicinity of the anode a fine mist or fog into the chamber. As the writer sees it there is bound to be a drift of particles toward the cathode and a gradual plating thereon—possibly resulting in a new kind of plated surface. If, in addition to this set-up, the article be heated by coils, the mist, as it settles, will be evaporated, and will therefore leave no drip. Of course this could be effected only with those plating operations where the mist, after delivering up its metal, could be evaporated.

It may be stated, finally, that there has been no unfavorable criticism to jet electroplating, but that all the differences of opinion have occurred on the spray idea.

Applications of the jet idea, in addition to those mentioned above as to re-entrant surfaced articles, may be many. For instance, suppose one desires to plate a copper name on an iron section of a boiler in place. The surface of the iron is waxed except for the name. A wire is hooked to the boiler for a cathode, the jet is started up and is played over the name, and there you are—maybe. The drip could be caught in a trough and returned to the container of the electrolyte.

1736 Good Hope Road,
Washington, D. C.

A. L. HODGES.

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Concerning Altruism in Equipment Manufacturing

To the Editor of Chem. & Met.:

Sir:—The article, "Are Equipment Manufacturers in the Consulting Business?" as printed in *Chem. & Met.* of January, 1929, was the first we have seen on a subject which has been given much study in our organization. Our company has been in the general piping business since about 1865, and 25 years ago we pioneered a new department—Fuel Economy Through Utilization of Exhaust Steam and Wasted Hot Water.

The opportunities for making money for manufacturing plants by applying a knowledge of certain laws of physics were almost numberless. Usually a brief preliminary survey enabled us to advise a prospect as to whether or not sufficient saving could be made to warrant the probable expense of making improvements. But, in order to answer the inevitable question, "What will it cost?" it was necessary to collect data, and sometimes spend many hours making calculations and preparing plans.

After our first few successful contracts we had no difficulty in getting opportunities to submit quotations. Satisfied customers told their friends, and we were kept busy following inquiries.

However, we soon found that the cost of making investigations for those who decided, for any one of a number of reasons, not to go through with the proposed plan, left us with a heavy unabsorbed expense which seriously affected our general overhead. The writer then took the stand that it was unfair for a prospect to expect us to incur expense to show him how he could make money, and then, because he did not care to make the necessary investment, leave us "holding the bag."

We undertook to sell the idea that it was worth considerable to a manufacturer to know what could be done, even if he did not care to do it. Enough of our prospects recognized the justice of this viewpoint so that we could afford to ignore the others. About all that is needed to sell this idea is *moral courage*. Most

equipment dealers are pitiably afraid, first, of competition, and second, same as the first. We recognize competition, but are not afraid of it. Our point of view is that we have something to sell which is worth the price we ask.

The way we handle this matter of engineering is by a statement inserted in our proposals to the effect that "Mr. Prospect agrees to reimburse us for the cost of the engineering expense incurred in making the investigation and submitting a report, whether or not the contract for doing the work is awarded to us, and in case the contract is not awarded to us all data obtained and plans prepared are to remain our property." We also include a statement to the effect that the plans and specifications are not to be used for the purpose of obtaining competitive bids.

This may at first appear to be very one-sided, but the point is, as just stated, Mr. Prospect only agrees to reimburse us for the *cost* of the investigation. This is an entirely different matter from an agreement to pay us for our engineering work and the knowledge which enters into it. This does not mean that we do not do engineering unless we do the construction work; if a prospect recognizes that we have had experience which is of value, we are prepared to undertake engineering including the furnishing of plans and specifications which the prospect may use for obtaining competitive figures. In such cases we charge a flat percentage rate based on the price for which the contract is finally closed, and do not attach any strings to the plans and specifications or informative data furnished.

It seems to the writer that the objection which Mr. Browne raises in this sentence: "Meanwhile the manufacturer must charge off the expense to his future sales, and the loss is passed on to the customers who actually buy," is equally true where later on he states: "If his proposal [meaning the successful bidder's proposal] is accepted, well and good—the cost of the survey will go into the overhead." Our attitude is that as this expense was incurred in connection with supplying information to the prospect, it should be paid by the prospect and not used to inflate general overhead expense.

In estimating the selling price of contracts, engineering expense relating to a prospect under consideration is considered as an item of cost to be included in the estimate for that particular contract. If the prospect pays for it as a separate item under the first clause of our proposal previously mentioned, it is *not* added into the cost of the contract or into the general overhead.

In one place Mr. Browne writes that it (the system referred to) cannot be carried out by one manufacturer or half a dozen. It is because of that statement that the writer has taken the liberty of submitting this letter. Knowing that it probably would be a waste of time to try to influence other firms in similar lines of business to see our point of view, we have gone on year after year independently along the lines covered herein, and as it has been proved to our satisfaction that the policy is sound, we probably shall continue to follow it regardless of what others may do.

TILDEN SPARKS.
Boston, Mass.

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To the Editor of Chem. & Met.:

Sir:—In reference to the article in *Chem. & Met.* entitled "Are Equipment Manufacturers in the Consulting Business?" the writer would say that the suggestion made by Mr. Browne is a very good one and has been proposed more than once, but it is rather difficult to get all the manufacturers of such equipment together and make them agree to certain rules regarding submitting propositions and doing investigation and survey work. It also is very difficult to define "development work of reasonable cost." What one manufacturer would consider reasonable another would consider outrageously high and still a third one would consider it negligible.

It would be quite an undertaking to get all the equipment manufacturers together and have them agree to certain standards regarding investigation, survey and development work. It will require someone to make a start and give up considerable of his time to get a program lined out and arrange for meetings, etc. However, if someone is willing to undertake this the writer believes that his company will be glad to partake in these meetings and assist in arriving at a solution.

Executive Engineer, G. L. KOTHNY.
C. H. Wheeler Manufacturing Company,
Philadelphia, Pa.

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To the Editor of Chem. & Met.:

Sir:—An article by J. Madison Browne, entitled "Are Equipment Manufacturers in the Consulting Business?" seems a very timely and worth-while discussion of a serious problem confronting many manufacturers. Having been in the specialty equipment business for many years, many situations have been encountered, the story of which could be read between the lines of Mr. Browne's discussion.

I believe it is a rather self-evident fact that the rôle played by the independent consulting engineer has become less important as the technical staffs and the research laboratories of the larger companies have become more proficient in dealing with their own problems. Nevertheless there is a large amount of consulting work which must be done, and whether this consulting work is done by the technical staff of an equipment manufacturing company or by a consulting engineer is entirely immaterial. The bill must be paid by someone.

As a counter-suggestion to the one which has been made by Mr. Browne, it appears to me that the great majority of cases could be handled by the simple expediency of making a flat charge for preliminary consulting services. If such a procedure were recognized as fair and legitimate, the manufacturer having a competent engineering staff would then obtain these consulting jobs strictly on the basis of merit. If he did not obtain any subsequent business, he would be paid for his effort and expense. If on the other hand he did obtain business, he could press payment of his bill, or waive the payment of same, as circumstances might dictate.

It is my opinion that in most cases it would be more satisfactory to clearly differentiate between the consulting work and the sale of equipment in the beginning than it would be to confuse the issue from the outset. By strictly eliminating consulting work from cost calculations the purchaser would be assured of fair competitive bids from the various manufacturers.

Obviously no change in the present situation can be brought about except through a program of education clarifying our understanding as to the factors entering into our complex industrial system, and no manufacturer could afford to take an arbitrary stand and thus be out of step with established practice.

Western Precipitation Company, WALTER A. SCHMIDT.
Los Angeles, Calif.

CHEMICAL ENGINEER'S BOOKSHELF

Engineering Technology Applied to Heavy Chemicals

INORGANIC CHEMICAL TECHNOLOGY. By *W. L. Badger* and *E. M. Baker*. McGraw-Hill Book Company, Inc., New York, 1928. 228 pages. Price, $2.50.

Reviewed by A. E. MARSHALL

AS ONE of the "Chemical Engineering Series," this volume was written, according to the authors' preface, primarily as a text for courses in the technology of the heavy chemical industry. We have far too few modern books on the manufacture of inorganic products, and there has been a lack of a concise general text outlining the reactions and processes involved in heavy-chemical production. The original Lunge is out of date, except for the valuable historical notes, while the newer many-volume Lunge is too ponderous for a text book and too diffuse and uncritical for the general reading purposes of students.

Messrs. Badger and Baker have compressed much useful information into their volume; they seem to have relied more on original information and less on shears and library paste than has been the case with some of the other works on inorganic chemical manufacture. To some extent this has resulted in an uneven treatment of materials. Common salt has been allotted thirty pages, whereas the fertilizer industry is dismissed in fifteen lines—despite the tabulation of sulphuric acid consumption on page 40 which accords fertilizer the premier place as a sulphuric acid consuming industry. Common salt, however, gave one of the authors a chance to include a useful discussion on evaporators, and the fertilizer industry is accustomed to being cast for the rôle of "atmosphere."

The process descriptions are unusually accurate, although in one or two minor cases plant operators would disagree with the authors' statements. The process flow sheets are well designed, and their inclusion for every important process should go a long way toward helping users of the book to visualize the complex steps which are necessary for the production of such "simple" substances as sulphuric acid, sodium carbonate and ammonia.

The reviewer has one regret. The authors in their introduction say "A discussion of chemical technology must embrace not only chemical and engineering theory, but also historical background and established practices." With a firm belief in the value of the historical background as a means of gilding the pill of proffered knowledge and aiding in its reaction and retention, the reviewer skipped along pursuing heavy-chemical history. A few lines on the Leblanc, Weldon and Deacon processes were the sole reward. There is some hope, however, in the imprint of "First Edition" on this volume, as perhaps when a second edition appears the historical material will be expanded and critically explained. At any rate, the historical material offered can hardly be said to square with that implied.

The present work should prove of value not only to teachers and students but also to technologists, for within its covers there is much useful knowledge of actual operations, presented clearly and without waste of words.

Carbon in Industry

INDUSTRIAL CARBON. By *C. L. Mantell*. D. Van Nostrand Company, Inc., New York. 410 pages. Price $4.50.

Reviewed by R. S. MCBRIDE

IN THE technical literature there are many so-called "monographs," but most of them are merely undigested and unreadable compilations of technical fact or opinion. This volume on industrial carbon seems to deserve in an unusual degree the designation "monograph:" it is a readable, well written, carefully digested summary of available information on the many forms and manifold uses of carbon.

On first reading one might accuse the book of superficiality, because it is so cleverly written, in an informal readable style, that it may give an impression of casualness. A second thoughtful consideration reveals the fact that all wanted information which could reasonably be expected in a volume of this size is present and that it is only the unexpected readability of the work that gives the first and erroneous impression.

The author of the work is to be congratulated on the very full cooperation which he evidently had from all industrial groups interested in any variety of carbon, ranging from diamonds to coke. He has made splendid use of these industrial sources and blended into a well proportioned whole a volume that will be widely welcomed.

The book is one in which the technical reader will find double interest. It is one that he can profitably peruse in odd times because of the general information afforded. It is also one that apparently will stand the test of frequent reference use.

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The Chemical Engineer Enters the Farmyard

FARM PRODUCTS IN INDUSTRY. By *George M. Rommel*. Rae D. Henkle Co., Inc., New York. 318 pages. Price $3.50.

IN VIEW of the attention and discussion devoted rather generally to the question of waste utilization and "paper from cornstalks" during recent seasons, a clarifying exposition of the subject became, to say the least, both fitting and proper. The results accomplished at Iowa State University have become current knowledge and the opportunity for true chemical engineering work in the exploitation of waste materials has been eloquently urged; still, there remained a place for a comprehensive treatment of this rather new agricultural phase.

Now that the effort has been made, there is good cause for satisfaction that the undertaking fell to the hands of Mr. Rommel. His survey and studies under Secretary Jardine—which really occasioned this book—allow of no doubt on the authority of his material; the only question that can reasonably confront the reader concerns its disposition and presentation. And it is in this light that Mr. Rommel's accomplishment seems an especially happy one. The conversational and personal tone of narration comes as easily as the gradual journey from the cellulose realm through to our native attempts

at rubber growing, and to the stimulating prospects in general for the chemist in agriculture.

The scope of interest for this book should extend from the technical man, as a matter of pleasure and education, to the lay reader with a live curiosity. Apart from the distinction of being the first one printed on "paper from cornstalks," it also offers the features of attractive illustrations, a thorough bibliography, and statistical appendixes.

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Two Standard Works Expand

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Vol. IX. By *J. W. Mellor.* Longmans, Green and Company, New York, 1929. 967 pages. Price, $20.

DESTINY, in the person of Dr. Mellor, provides us with its recurrent, apparently infallible, signs of the passing seasons. The manifestation this time is the ninth in the surprising series initiated by him in 1922, consequently the time seems near when the four remaining volumes will have crowned the author's productive and highly individual triumph.

The elements represented in this volume are arsenic, antimony, bismuth, vanadium, columbium, and tantalum. A rather diversified list; but those readers who are accustomed to the even, scholarly treatment accorded to the preceding volumes will not wonder that the subjects receive full justice here too. Single authorship has its advantages in those cases when the qualified man has the enthusiasm to undertake so compendious a work; the standard features, then, of the series—pithy information on one hand and detailed reference on the other—are again present in Vol. IX. Dr. Mellor further enhances these advantages with a conversational, unpretentious manner that breathes life into a rather bulky body.

A Textbook of Inorganic Chemistry, XI: Organometallic Compounds, Groups I to IV. By *A. E. Goddard* and *Dorothy Goddard;* edited by *J. Newton Friend.* J. B. Lippincott Company, Philadelphia, 1928. 418 pages. Price, $14.

Conceivably it will require an unusual urge for knowledge on organometallic compounds to part with the appointed sum for a volume of such normal dimensions. But its source stands in deserved favor, so that a prospective seeker of information will let its status as one of the Friend series be his guarantee. As the first part among three on the subject it covers the derivatives of Groups I to IV of the periodic system. Within this range, however, the compounds of mercury, tin, and lead are of predominant interest, and it is to these that the major portion of the book is devoted. The other elements enter only to the limited extent of their combining powers. Considering the 2,300 compounds treated throughout the book, a work is being offered that should also prove of great reference value in a field where little organized publication has been done.

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A Dictionary for Chemical Engineers

Chemisches Fachwörterbuch. Vol. I, German-English-French. By *A. W. Mayer.* Otto Spamer, Leipzig, Germany. 1929. 825 pages. Price, 70 M.

WHILE there are actually several dictionaries for these languages available, none of them has been found entirely adequate for the specific terminology of chemical engineering; nor is this surprising, in view of the expense and labor that would be required for service to so specific a field. Muret-Saunders and Tolhausen, for example, are admirable in their scope, but this is too broad for detailed attention to industrial chemistry. The Patterson books are also valuable—always taking into account, though, their professed aim.

In his effort to "take the bull by the horns," then, in the interest of chemical-engineering intelligibility the author has not merely contented himself with translated equivalents but has also added special phrases and short explanations wherever helpful. In this first volume the starting-point is German throughout, and while the translations in many cases involve only transcription the material offered to the word-hunter is copious and accurate. Americans and Britishers will undoubtedly find the prospective English-German-French volume of greatest value.

No actual lexicographic sins have been detected, but "rayon" should certainly have appeared as variant for "artificial silk," and occasionally the English diction is quaint though never incorrect. As a product of bookmaking the bulky volume reflects further credit on its publishers.

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Graphs to Simplify Calculations

Chemische Nomogramme. First group. By *Otto Liesche.* Published for the Deutsche Gesellschaft für Apparatewesen. Verlag Chemie, G.m.b.H., Berlin, 1929. Price, 2 M.

THIS is a new collection of graphs for simplification of calculation in chemical processes. An explanation appears on the covers of the folder, the problems undertaken in this first collection being percentage mixtures; density—Baumé degrees; factor for reducing gas volume to standard, weight of 1 c.c. of N_2, vapor pressure of water at 5 to 26 deg. C.; S precipitated as $BaSO_4$; P and P_2O_5; iron determination (25 to 65 per cent) by permanganate.

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Recently Arrived

Questions d'Actualité, Rapports et Discussions. 3rd Chemical Council of the Solvay International Institute, Brussels, 1928. Gauthiers-Villars & Cie, Paris, 1929. 562 pages. Price, 70 F.—Report of the third of the councils maintained by the Solvay family, comprising the papers presented under the chairmanship of Sir William Pope in April, 1928.

Six-Place Tables, 3rd Edition. By *Edward S Allen.* McGraw-Hill Book Company, Inc., New York, 1929. 167 pages. Price $1.50. The subject matter, obviously in demand, includes logarithms, trigonometric functions, roots, powers, and other useful mathematical factors.

British Chemicals, Their Manufacturers and Uses. Published for the Association of British Chemical Manufacturers by Ernest Benn, Ltd., London, 1929, 330 pages. Price, free on application.—This handsome volume offers a content that makes it outstanding among trade publications. Its lists comprise members of the Association, classified products, proprietary names, and an index; the matter is conveniently arranged and appears in six different languages.

Official Directory of the British Chemical Plant Manufacturers' Association—Published by the Association, at London. 119 pages. Price, free on application.—Chemical apparatus listed by manufacturers and by types

Méthodes et Procédés Metallurgiques. By *M. Regnauld.* Gauthiers-Villars & Cie., Paris, 1929. 342 pages. Price, 60 Fr.

Selections from Recent Literature

DRYING AND COOLING. — Constantin Redzich. *Apparatebau,* Feb. 22, pp. 37-9. For drying air in large quantities, e. g. for blast furnaces, it is expensive to use anhydrous salts or sulphuric acid and the reagents are corrosive or otherwise difficult to handle. Sulphuric acid, for example, must be cooled to carry away the heat of dilution, and it becomes highly corrosive if dilution is allowed to go about 50 deg. Bé. or lower. Drying by compression and refrigeration is expensive in plant requirement and power consumption. Drying with an adsorbent does not have these difficulties; the adsorption is reversible and total drying costs are relatively low. Numerous natural materials are active adsorbents, e. g. bauxite and other aluminum minerals, fulllers earth, wood charcoal, etc.; but they lack uniformity, or are not active enough with respect to water vapor, or have other drawbacks. Silica gel is the one adsorbent which fulfills the requirements of activity, uniformity, mechanical strength and durability. In drying effectiveness (i. e., vapor pressure of water from its surface) it stands between sulphuric acid and phosphorus pentoxide. Almost the only power requirement in using silica gel is the heat energy used in reactivation. The cost of installation is low; it is only necessary to build a sufficient number of adsorption chambers, part to be in use while the remainder are removed from the system for reactivation. Cheap, light materials can be used because no provision is necessary for corrosion or high pressure. Costs are tabulated for a blast furnace with a weekly capacity of 1330 tons of iron, using 565 cu.m. of air per minute. Under the conditions specified, the cost was 0.94 Marks per ton of iron produced, and the savings effected by drying the air amounted to 3.97 Marks per ton, leaving a net saving of 3.03 Marks. An air drying installation for a cable factory also is described.

ELECTROPLATING. W. Pfanhauser. *Chemiker-Zeitung.* Feb. 13, pp. 129-30. Electroplaters are already making use of instruments for measurement and control of temperature, pressure and acidity in electrolytic baths. But another necessity is to control the thickness of the deposit by suitable regulation of the current density. To meet this need the LPW current density meter has been developed. It consists of two round comparator electrodes in a hard rubber housing, insulated from each other and connected together across a small meter. The instrument must be calibrated according to the solution in which it is to be used and must be placed in proper position with respect to the anode and cathode. It serves to show the time required for a given thickness, and also helps maintain quality by keeping the current density within proper limits. Illustrated.

LIQUID FUEL. Bruno Mueller. *Apparatebau,* Feb. 8, pp. 31-3. The hazards in storing and using liquid fuels are mainly of fire, explosion of vapor-air mixtures, and poisoning by inhalation of the vapor. Safety precautions and devices against each of these dangers are described and discussed. A particularly cheap and effective safety measure is to use the water displacement method for discharging gasoline or oil from tanks, instead of a pipe reaching to the bottom of the storage tank. Use of an inert gas to fill vacant spaces and for discharging pressure also is effective, but is relatively more troublesome and expensive.

VAPOR TEMPERATURE. K. Schreber. *Chemische Apparatur,* Feb. 10, pp. 21-4. The importance of knowing the true temperature of a vapor escaping from a solution, for calculating the proper effective heating surface in evaporators, is emphasized. Textbook thermodynamics, dealing only with states of equilibrium, will not solve the problem. Practical considerations therefore are employed. It is shown that the vapor, having at the instant of escape the same temperature as the boiling point of the pure solvent, becomes immediately subject to radiation and convection from the solution and the vessel walls for a time, depending on conditions. During this time its temperature is between the boiling points of pure solvent and solution and depends on the properties of the solution and the vessel walls. From a calcium chloride brine, b. p. 116 deg. C., the vapor was at 104.8 deg. in a bright vessel and 107.2 deg. in a black vessel. To minimize radiation, vessel walls should be as bright as possible.

CONTACT CATALYSIS. G. M. Schwab and E. Pietsch. *Zeitschrift für Elektrochemie,* March, pp. 135-41. The topochemistry of contact catalysis is discussed in the light of recent quantitative observations, treatment of this type of catalysis having hitherto been mainly qualitative. Starting with the conception of the active centers as lines homogeneous in themselves, it has been found possible to correlate the catalytic process with values which can be directly measured, such as excess energy of active centers, or increases and decreases in activity. It is hoped through such measurements to ascertain the laws which actually govern contact catalysis.

CRACKING PROCESSES. Albert P. Sachs. *Chemiker-Zeitung* Jan. 23, pp. 65-6; Jan. 30, pp. 86-8; Feb. 6, pp. 107-8; Feb. 20, 147-9; Feb. 27, 167-8. The origin and theory of the cracking of heavy hydrocarbons to produce volatile hydrocarbons are presented. In modern cracking, carbon deposition is largely avoided by temperature control, local overheating being blamed when carbon is deposited. Cracking processes are reviewed under three headings: liquid phase, vapor phase and catalytic. Though Rittman contended that vapor-phase cracking has both theoretical and practical advantages, commercial development has been more favorable to liquid-phase processes. This is largely because the vapor-phase processes cause more unsaturation, thus adding to the difficulty of refining and using the products. The fundamental variables in cracking are time, temperature, pressure and composition. Efficiency and quality of product can be largely influenced by proper control of these. The processes described in the review are those of Burton, Cross, Dubbs, Richey, Holmes-Manley, and Rittman (cracking of gases). The Knox process apparently solves many of the problems of vapor-phase cracking.

POWDERED COAL. L. Monnoye. *L'Industrie Chimique,* Dec. pp. 577-80; Jan. pp. 8-12; Feb. pp. 68-71. Modern methods and equipment are described for preparing and using powdered fuel, particularly coal. Processes include classifying, cleaning, grinding, separating and conveying, before actual use. Percussion grinding is emphasized, and the Forplex percussion machine, a combined pulverizer and separator, is described and illustrated. Methods of combustion, securing optimum heating effect by greatest possible utilization of the radiant heat, include the Lopulco, Lopulco-Roubaix, Duquenne and vibratory combustion systems. Vibration accelerates the combustion by constantly modifying the conditions of the medium and by breaking up states of dynamic equilibrium which, though brief in actual time, last long in relation to the instantaneous reaction which they tend to interrupt.

TESTING REFRACTORIES. Willi M. Cohn. *Chemische Fabrik,* Feb. 13, pp. 75-7; Feb. 20, pp. 88-9. Methods of testing refractories for resistance to hot slag include heating the slag on the surface or in a depression in the refractory; dipping the refractory in the slag; continuous addition of slag to refractory; the cone test, and the crucible test. After the test, penetration and other effects are observed and chemical analyses are made. But these tests are largely empirical; more knowledge is needed of what actually happens when a molten material attacks a refractory under service conditions. A preliminary study has revealed some regularities which will be followed up. Solution of this problem would be a great benefit to technology.

ALLOYED STEELS. B. P. Haigh. *Chemistry & Industry,* Jan. 11, pp. 23-30. With the increasing use of high tensile alloyed steels in chemical plant equipment, factors of safety calculated for mild steel have often been applied to the new steels. It so happens that the relation between yield strength and fatigue strength of mild steel is such that fatigue cracking is not common under ordinary usage, but this is not necessarily true of the newer alloy steels.

Numerous tests and experiments with alternating and pulsating stresses have shown that in some of the high tensile steels these two strengths are so related that fatigue cracking is more frequent. Standard testing is very important and it is proposed that a flat strip with a small hole drilled in it be adopted as a second standard test piece. This form would give information not obtainable from a cylindrical test piece. Tables of data and curve charts show the comparative relations between fatigue and yield strengths of mild and high tensile steels. Tests made on the Haigh fatigue testing machine, which is described and illustrated, are reported and discussed in connection with the graphic comparisons.

SURFACE ENERGY. W. E. Gibbs. *Chemistry & Industry*, Feb. 8, pp. 127-36. Surface energy, or energy at interfaces, has much to do with the processes involved in separating or aggregating particles. Hence grinding and pulverizing, atomizing of liquids, condensation of vapors, coagulation, flocculation, clarification of liquids, de-emulsification, ore flotation and wet grinding (e. g., pigments in oils) must all be performed with due regard to the laws of surface energy. The industries employing one or more of these processes as major operations are many and diverse, a few conspicuous examples being lubricants, rubber, soap, rayon, cement, plastics, coatings, etc. Without attempting to review specific applications, a general account is given of the nature of these forces and the laws by which they influence the physical and chemical behavior of materials.

Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Tariff Information. Two sets of volumes are now available from the Government Printing Office which give in full detail information bearing on tariff questions as presented to the Ways and Means Committee of the House of Representatives. This information has wide industrial usefulness because of the statistics contained and the discussion of economic relations. The first set of volumes gives the minutes of the hearings before the Ways and Means Committee, published in seventeen volumes, the first fifteen corresponding to the fifteen schedules of the Tariff Act of 1922 and the other two dealing with administrative features and a group of miscellaneous supplements. Those interested in particular parts should communicate with the Superintendent of Documents for detailed information.

The second series of documents consists of 15 volumes, listed below, which are entitled, "Summary of Tariff Information," and relate respectively to the commodity groups indicated: (1) Chemicals, Oils, and Paints, 419 pages, 40 cents; (2) Earths, Earthenware, and Glassware, 168 pages, 20 cents; (3) Metals and Manufactures of, 328 pages, 35 cents; (4) Wood and manufactures of, 51 pages, 10 cents; (5) Sugar, Molasses, and Manufactures of, 43 pages, 10 cents; (6) Tobacco and Manufactures of, 17 pages, 5 cents; (7) Agricultural Products and Provisions, 488 pages, 60 cents; (8) Spirits, Wines, and Other Beverages, 21 pages, 5 cents; (9) Cotton Manufactures, 78 pages, 10 cents; (10) Flax, Hemp, Jute, and Manufactures of, 57 pages, 10 cents; (11) Wool and Manufactures of, 73 pages, 10 cents; (12) Silks and silk Goods, 64 pages, 10 cents; (13) Papers and Books, 71 pages, 10 cents; (14) Sundries, 281 pages, 25 cents; (15) Free List, 516 pages, 45 cents.

Cast Polished Plate Glass. Issued by the U. S. Tariff Commission. 10 cents. Report of the U. S. Tariff Commission to the President, with appendix proclamation by the President.

Census of Dyes and Synthetic Organic Chemicals. Mimeographed document issued by the U. S. Tariff Commission, containing a preliminary report of the census of production in 1928.

Effects of Refrigerant Vapors. Public Health Service Bulletin 185. 15 cents. Physiological response attending exposure to vapors of methyl bromide, methyl chloride, ethyl bromide, and ethyl chloride.

The Computation of Fertilizer Mixtures from Concentrated Materials, by Albert R. Merz and William H. Ross. Revised edition, dated January, 1929, of U. S. Department of Agriculture Department Bulletin 1280. 5 cents.

Discharge Coefficients of Square-Edged Orifices for Measuring the Flow of Air, by H. S. Bean, E. Buckingham, and P. S. Murphy. Bureau of Standards Research Paper 49, reprinted from Bureau of Standards Journal of Research issued in March, 1929. 20 cents.

Recommended Specification for Quicklime and Hydrated Lime for Use in Soap Making. Bureau of Standards Circular 372. 5 cents.

Specifications and Tolerances for Commercial Weighing and Measuring Devices. Bureau of Standards Handbook, Miscellaneous Series 85. 50 cents. Specifications and tolerances for commercial weights and measures and weighing and measuring devices, as adopted by the National Conference on Weights and Measures and recommended by the National Bureau of Standards for adoption by the several states.

New Statutes for Nitrate Association, by Commercial Attaché Ralph H. Ackerman, Santiago, Chile. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 262. Mimeographed.

British Colonial Office Reports on the Rubber Situation, compiled by E. G. Holt. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 603. 10 cents.

Market Data Handbook of New England. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series 24. $1.75. A thorough analysis of trade territories, maps of trade territories, railroads, and highways—pertinent data for building sales quotas.

German Chemical Developments in 1928, by William T. Daugherty. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 605. 10 cents.

International Trade in Petroleum and Its Products. Bureau of Foreign and Domestic Commerce Trade Promotion Series 80. 25 cents.

Report III of the Federal Oil Conservation Board to the President of the United States, February 25, 1929. Department of Interior document. 30 cents.

Petroleum Refinery Statistics, 1927, by G. R. Hopkins. Bureau of Mines Bulletin 297. 20 cents.

Specific Heats of Gases at High Temperatures, by E. D. Eastman. Bureau of Mines Technical Paper 445. 10 cents.

Terminology in Coal Research, by Reinhardt Thiessen and Wilfred Francis. Bureau of Mines Technical Paper 446. 10 cents.

Factors Governing the Entry of Solutions Into Ores During Leaching, by John D. Sullivan, Walter E. Keck and George L. Oldright. Bureau of Mines Technical Paper 441. 10 cents.

Batch Classification in the Laboratory, by A. W. Fahrenwald and Clarence Thom. Bureau of Mines Serial 2924.

Nineteenth Semi-Annual Motor Gasoline Survey, by E. C. Lane, D. B. Taliaferro, Jr. and S. S. Taylor. Bureau of Mines Serial 2916.

A Study of Gauze Heating in Miners' Flame Safety Lamps, by E. J. Gleim, A. B. Hooker and P. G. Guest. Bureau of Mines Serial 2913.

A New Type of Laboratory Dust-Explosion Apparatus, by C. M. Bouton, C. H. Gilmour and Garnet Phillips. Bureau of Mines Serial 2927.

Mineral production statistics for 1927—separate pamphlets from Bureau of Mines on: Asbestos, by Oliver Bowles and B. H. Stoddard, 5 cents; Stone, by A. T. Coons, 10 cents; Cadmium, by Paul M. Tyler, 5 cents; Phosphate Rock, by B. L. Johnson, 5 cents; and Lead, by Lewis A. Smith, 10 cents.

Mineral production statistics for 1928—preliminary mimeographed statements from Bureau of Mines on: Fuel Briquets; Phosphate Rock; Salt, Bromine, and Calcium Chloride; Magnesium; Magnesite; Slab Zinc and Rolled Zinc; and Fluorspar.

Production statistics from 1927 Census of Manufactures in preliminary mimeographed form for: Manufactured gas; leather belting; concrete products; sand-lime brick; pig iron and ferro-alloys; steel-works and rolling-mill products; tanning materials, natural dyestuffs, mordants and assistants, and sizes; petroleum refining; wood distillation and charcoal manufacture; paints and varnishes; and miscellaneous roofing materials.

THE PLANT NOTEBOOK
an exchange for OPERATING MEN

Method for Detecting Scale in Evaporators

By J. W. Montgomery
Eleele, Hawaii

IN PROCESS INDUSTRIES where multiple-effect evaporators are used it is often difficult to determine during operation when the tubes are scaled to an extent that requires cleaning. The following method has been found to be effective in sugar factories:

Shortly after starting to boil and when the tubes are known to be clean, temperature readings are taken on the vapor space of each cell. At suitable intervals readings are taken as above, the steam pressure on the first cell and the temperature in the vapor space of the last cell remaining constant in all cases.

Since most industries have a scale of more or less constant composition, the type of scale and the amount may be quite accurately determined for each cell. While no method will take the place of a careful inspection by the foreman in charge of cleaning, the method given here may also be used as a check on the operation by the superintendent.

A table of typical data will illustrate the system. In this example the scaling is quite progressive, although the fourth cell is shown to have a heavy incrustation. In many cases the presence of a scale having a high silica or organic content is shown by a large temperature difference between the first and second cells, while a carbonate or sulphate scale is indicated when the temperature difference between the third and four cells is abnormally large.

The writer has found the above information of value not only in knowing the condition of the cells as regards cleanliness but also in knowing to a certain extent the proper chemical treatment to give them in removing or softening the scale. By having the operators keep a log sheet, any irregularity in operation can be detected by those in charge. Improper venting of non-condensable gases, air leaks, oil deposits on the steam side of the tubes, excess friction in catch-alls, as well as condenser and vacuum pump efficiencies are readily brought to light.

Modern multiple-effect evaporators are carefully designed and with proper care and operation will give long, trouble-free service. Attention to details on the part of those qualified to analyze small difficulties will save a large amount of trouble later.

Typical Temperatures in a 4-Effect Evaporator

(*a*) Cells clean; (*b*) after 3 days; (*c*) after 6 days

	Lb. Pressure 1st cell	Temp. Deg. F. Corresponding to 5 lb.	Temp. Deg. F. 1st cell	Temp. Deg. F. 2nd cell	Temp. Deg. F. 3rd cell	Temp. Deg. F 4th cell
(*a*)	5	227	220	210	185	130
(*b*)	5	227	218	208	190	130
(*c*)	5	227	216	207	195	130

	Steam Temp. — Temp. 1st cell	Temp. 1st cell — Temp 2nd cell	Temp. 2nd cell — Temp. 3d cell	Temp. 3rd cell — Temp. 4th cell
(*a*)	7	10	25	55
(*b*)	9	10	18	60
(*c*)	11	9	12	65

Gaging Tanks and Tank Cars

By H. L. Kauffman
Denver, Colo.

GAGING is the act of measuring the depth of liquid in a tank, or ascertaining the amount of liquid by measuring the distance of the surface from the top of the tank.

Stationary Tanks.—Float gages may be made the most accurate form of gage for stationary tanks. In the functioning of this type, the float rides on the surface of the liquid, always sinking into the liquid to a constant distance. The float is connected by a chain or cable or hydraulic transmission to an indicator which moves over a fixed scale. The scale may be arranged to read either depth of liquid or the distance from the liquid surface to the top of the tank, which latter is known as "outage gaging." Outage gaging is nearly always used for tanks with sloping or conical bottoms, and for containers that are always gaged when almost filled (e.g., tank cars). Float gages are often used as rough indicators of the amount of liquid in tanks, since they show at a glance (and from a considerable distance) the approximate gaging.

Calibrated gage rods of wood or graduated steel tape lines with a plumb-bob on the end are used most generally for stationary tanks. These are lowered vertically into the liquid until the bottom of the tank is reached, then withdrawn, and the length of the tape or rod wetted by the liquid is read. Care should be taken to lower the rod vertically, always as near to the same place as possible, and to withdraw it easily without agitating the surface of the liquid.

In the case of tanks containing oils, if it is desired to learn the approximate amount of water in the tank, the rod or tape is chalked at the bottom; water wets a chalked surface but oil does not.

The personal equation is an important factor in rod or tape-gaging, as very seldom do two men obtain the same reading in a given case. Gage readings should be recorded immediately after being taken.

Effect of Temperature on Gaging.—The temperature of the liquid gaged should always be recorded if an accurate reading is desired, this being necessary due to the thermal expansion of the liquid. The standard temperature for the measurement of oil is 60 deg. F., to which temperature the volume readings at all other temperatures must be corrected.

The coefficient of expansion in per cent volume change for a change in temperature of 1 deg. F. for petroleum oils varies somewhat with the temperature range and with change in gravity, as shown below:

Specific Gravity, Deg. A. P. I.	Coefficient of expansion
79.0 and lighter	0.0008
78.9–65.0	0.0007
64.9–51.0	0.0006
50.9-35.0	0.0005
Heavier than 35.0	0.0004
Pitches	0.00036

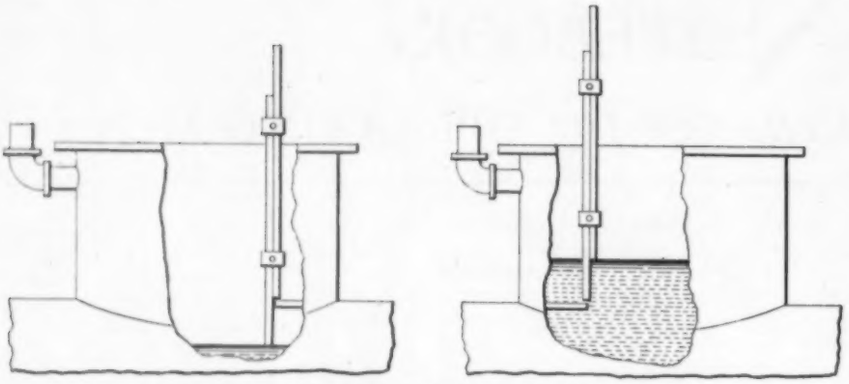
Obviously, if the oil in the tank is under 60 deg. F., the correction is added to the volume reading, but if it is over 60 deg., it is subtracted. A frequent practice for approximate results is to subtract or add 1 per cent for temperature differences, which vary with the different oils as follows:

	Temperature difference, Deg. F.
Gasoline	15
Kerosene and heavy naphthas	20
Gas oil, fuel oil and lubricating oils	25

Use of "Thiefs."—When it is desired to obtain a representative sample of a liquid from a tank, this may be accomplished most conveniently by means of a piece of apparatus called a "thief." The thief can be lowered to any desired depth in the liquid and there opened, taking a sample of liquid at that point in the container.

Thiefing is sometimes resorted to also in determining the quantity of water contained below the oil layer in a tank. Measurements for water usually are necessary only for inventories, or when an empty tank is filled, a tank pumped out completely, or when water is drawn off. Water measurements may be neglected for ordinary transfers of oil, where the difference between a "before" and "after" gaging is entirely represented by oil volume.

Tank Cars.—The most commonly used method of gaging the innage (amount of liquid in the dome) or outage of a tank car—although far



Illustrating Double Gaging Rule Measuring Outage at Left and Innage at Right

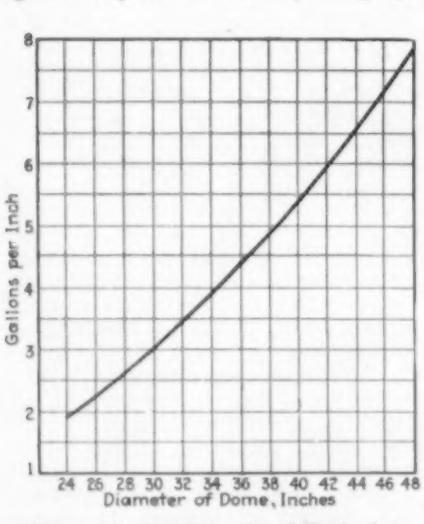
from the most satisfactory—is to use a 3-ft. rule to measure the distance between the edge of the tank shell and the surface of the liquid. Inaccurate readings are likely to be obtained with this method for outage measurements in view of the fact that the man doing the gaging has to look at the angle at the mark on the rule at the point where it is even with the top of the shell. When there is liquid in the dome of the car—that is, innage—the common practice is to lower the rule through the liquid until its end rests on the tank shell inside the dome, thereafter reading the highest point on the rule that is wet. It is not so difficult to obtain accurate innage readings. A more satisfactory means, in the writer's opinion, is the use of some such gage as the Mayhall, by which accurate readings are quickly obtained with the same instrument that is used in sampling and in getting the temperature of the liquid in the car.

Another satisfactory means of ascertaining innage or outage volumes consists in the use of two rules, each about 30 in. long, fastened together parallel to each other by two sliding brass guides on one of which is a clamp operated by a thumbscrew controlling the movement of the rules. Brass tips on the ends of the rules prevent damage and at the same time act as a safeguard against explosions from sparking (if the car contains a flammable liquid), such as might occur in striking a steel-shod rule against the steel of the tank car.

The rules are graduated in inches and in fractions of an inch, but numbering is in opposite directions: one rule reads from 0 to 30 in., the other from 30 in. to 0. In using this measuring device when there is outage—that is, when the liquid level is below the top of the shell—the end of one of the rules is first allowed to rest on the edge of the top of the shell. Next, the thumbscrew is tightened to a point where the other rule will not drop down, of its own weight, but will still move downward slightly when its top is lightly tapped.

The tapping is done by the gager until the bottom of the free rule being tapped just touches the surface of the liquid, causing a ripple. The top of the free rule is then just opposite the figure on the stationary rule that represents the distance between the top of the shell and the surface of the liquid. Innage gaging with this device is identical with the procedure just described, except that one of the rules is pulled well up above the height of the liquid in the top and thereafter gradually tapped down until it touches the liquid surface.

Curves or table may be used in determining innage or outage. The accompanying curve shows gallons per inch in tank-car domes of various sizes. It is, of course, only necessary to add the car capacity to the dome contents to obtain the actual car contents, uncorrected for temperature. As in the case of stationary tanks, it obviously is desirable to make temperature corrections to 60 deg. F., especially in the case of liquids bought and sold on a volume basis.



Curve Showing Capacity of Tank Car Domes of Various Diameters in Gallons per Inch of Depth

Emergency Repair Kinks

By A. W. Bull
Naugatuck, Conn.

In the operation of chemical plants where emergency repairs must be made with the least possible loss of time, work is frequently considered impossible until hot solutions have been removed from the tank, floor or sump where the repair is to be made. If the breakdown is due to a pump failure or to pipe line stoppage the removal of hot solutions may be difficult. Emergency work under such circumstances can be made, however, without complete draining, by men wearing rubber boots filled with cold water. A pair of hip boots filled with cold water will enable the wearer to walk through or stand in nearly boiling water for at least ten minutes particularly if the toes are frequently wiggled to circulate the water inside the boot.

It is sometimes necessary to do work inside hot tanks that have just recently been drained. In some cases the tanks cannot be cooled with water alone because of the excessive volume required. A method which will frequently suffice is to use a large atomizer made by bringing a water and air hose to the same ¾-in. tee and having a 6-in. piece of pipe as nozzle in the third tee opening. In this way a small amount of cold water combined with the air blast gives a remarkable cooling effect on the air in a steaming hot tank and permits emergency repair work without waiting for the tank itself to cool.

Heating Asphalt Electrically

By H. E. Scarbrough
General Electric Company
Chicago, Ill.

The Wood Conversion Company of Cloquet, Minn., having need for a tank which would hold about 7,000 lb. of melted asphalt, recently installed an electrically heated unit with excellent results. The asphalt is used in the manufacture of wood fiber blanket for insulating refrigerator cars, and glues the wood fiber to a stiff paper.

The tank installed is a vertical one, 4 ft. square by 8 ft. deep. It is heated by five 3.8-kw. G. E. form G heaters on each wall, outside. In addition, it is insulated with 6 in. of good heat insulating material, including the cover. An automatic control panel and a Bristol instrument are used to maintain the temperature in the chamber outside the tank.

With this outfit, asphalt is melted very readily, a uniform temperature is maintained and there is no stoppage of the discharge pipe because it is brought out through the bottom of the heating chamber.

A recent analysis made at the plant shows that, figuring a 24-hour day, the total power consumption is 390 kw.-hr. The tank, with its 7,000 lb. of asphalt, is maintained constantly at a temperature of 400 deg. F. During each 24 hours, 4,000 lb. of cold asphalt is added, and 4,000 lb. removed for process work; in other words, the 390 kw.-hr. are used to maintain 7,000 lb. of asphalt at a temperature of 400 deg. F. for 24 hours and to heat up to that temperature an additional 4,000 lb. At the company's power rate, the cost amounts to $2.92 per 24 hours, which is less than the interest on the investment would be if an oil burner had been installed as originally planned.

EQUIPMENT NEWS *from* MAKER *and* USER

Chemical Exposition Shows Progress in Plant Equipment

AS THIS ISSUE of *Chem. & Met.* goes to press the Twelfth Exposition of the Chemical Industries passes into history. A foot-weary editor has made his last round of the three exposition floors at the Grand Central Palace and sits down to take stock of the week's conversations and meanderings.

The editorial aim is to discover trends and to point to tendencies. From that standpoint, the net result of the show was perhaps a little disappointing. Lacking other sources of information, such as the students' courses which were conducted simultaneously in the exposition building, the visitor would conceivably be at a loss to discover just where the chemical engineering industries were headed. This lack of definition is to be traced directly to the absence of exhibits in several important equipment fields and, even more regrettably, to a distinct falling off in the number of exhibitors of chemical products. The chemical show appears to be becoming more and more an equipment manufacturers' exposition, whereas from every standpoint it would seem desirable to have adequate representation by both equipment and chemical producers.

If the exposition failed to present a complete picture of the modern trends in the chemical engineering industries, it was in no way the fault of the exhibitors who were present. As a medium for the exchange of ideas and for the propagation of new doctrines in manufacturing equipment, the show was as valuable as ever. Many improvements in equipment were in evidence, a number of new chemical products were shown and a few radically new types of apparatus appeared.

IT IS, of course, impossible to gage an exposition on the basis of the volume of new equipment in evidence. As radically new forms were not frequent, it suggests the possibility that equipment manufacturers are approaching a point in the perfection of their apparatus which will mean comparative stability for some time to come. This does not mean, however, that refinements are not constantly being made in many types of equipment. Small refinements in detail are frequent, where, for example, apparatus is arranged for direct motor drive or has anti-friction bearings substituted for the solid type. Other manufacturers are expressing new eagerness to co-operate with equipment users in the matter of suitable materials of construction, while there is further evidence of improvement in efficiencies of one kind or another.

Two exhibits of new alloys attracted an unusual share of attention. One, the exhibit of the several companies operating under the patents of the Krupp Nirosta Company, Inc., of New York, showed numerous examples of the various forms in which these chromium-nickel steels are applicable. These are the much heralded Nirosta alloys developed by Dr. Benno Strauss of the Krupp firm in Germany. The alloy known as Enduro (or Rezistal) KA2, an austenitic steel containing 18 per cent chromium and 8 per cent nickel, is the alloy being featured at present. This material appears to have a relatively enormous range of application where corrosion resistance is important together with excellent working properties.

ANOTHER alloy was shown by the Duriron Company, Dayton. This is a new austenitic steel known as Durimet and is an alloy containing iron, nickel, silicon and copper. It may be cast, drawn, welded and forged and is said to be very ductile in the cold state. The rolled stock has an ultimate tensile strength of 90,000 lb. while the castings show an ultimate tensile of 75,000 lb. The steel is tough and non-magnetic. It is obtainable in the form of sheets, bars, rods and castings, and is suitable for use with sulphuric acid of concentrations up to 50 per cent. Its further applications are at present being investigated by the Duriron Company.

Another new metal, shown for the first time in commercial form, was Columbium, produced by the Fansteel Products Company of Chicago. This is a white silvery metal with characteristics, so far as they are known, quite similar to tantalum.

There were several interesting developments in liquid handling equipment. Two of the stoneware companies, the General Ceramics Company of New York and the U. S. Stoneware Company of Akron, showed new stoneware centrifugal pumps. The pumps of each of these manufacturers are available in a number of sizes, the former in capacities from 8 to 800 gallons per minute and heads to 100 feet. This pump uses a shrouded impeller, an innovation, it is believed, in stoneware pumps. The U. S. pump line includes two models with capacities of 225 and 500 gallons per minute, respectively.

Among the all-metal pumps there was a new model made by the Duriron Company which incorporates a self-priming feature for the first time in this company's equipment. The LaBour Company of Elkhart, Ind., is offering a new design in its self-priming pump. The new design features an improved impeller casing and a new pump and motor base. A new type of gear pump was shown by the Northern Pump Company of Minneapolis. This is the Hawley type, intended for service with any clean, non-corrosive liquid. This pump is a novel departure in that the pumping gears are driven by a third pinion rather than from the shaft of one of the gears. This is said to result in the elimination of shaft deflection and a consequent longer life for the pump.

Among valves, three new types were shown. A valve put out by the Northern Pump Company is of the lubricated plug cock type, and utilizes rings of packing material above and below the plug. If this cock should stick it may be released by a blow upon the lower end of the plug. Another new valve is of the Y type, made by the Duriron Company. This employs a spherical plug and a conical seat and features an especially straight fluid passage with Duriron everywhere in contact with the liquid handled. A third valve, built by Merco-Nordstrom Valve Company of Los Angeles, is again of the lubricated plug cock type, similar to the valves previously produced by this company except that the fluid passages are similar to a Venturi and are thus said to result in the recovery of practically all of the valve pressure loss.

THERE were several interesting developments in evaporators. The Struthers-Wells Company of Warren, Pa., has introduced an entirely new design in climbing film evaporators. This is an inclined rapid-circulation type which eliminates the usual vapor space and uses an improved and novel entrainment separator which is said to be extremely efficient. This evaporator is built as a unit consisting of an automatic feed regulator, the evaporator proper, the separator and the condenser. It may be used in single or multiple effects and is said to be adaptable to any material which does not salt out during evaporation.

Another evaporator, new to the chemical industries, but previously used in connection with the de-alcoholization of beer and other similar food applications, is being made by Zahm & Nagel of Buffalo. This is an innovation for the chemical industries. It consists of a vertical steam-jacketed casing in which a four-bladed impeller rotates with a peripheral speed of 1,500 feet per min-

ute. This rotation insures that the material undergoing evaporation will form a thin film upon the inner heating surface so that the passage of the material through the evaporator is very rapid. This machine is intended particularly for applications where there is difficulty with foaming. It may be operated in single or multiple effect at atmospheric or reduced pressure.

Further improvements in evaporators have been effected by the J. P. Devine Manufacturing Company and the Buffalo Foundry & Machine Company, both of Buffalo. The former company is introducing a new rapid circulation evaporator which makes use of a set of vertical tubes and a very large entrainment separator that incorporates also storage capacity. This feature is said to permit extreme flexibility of operation. The latter company's improvement constitutes a change in the type of entertainment separator employed on rapid circulation evaporators. It consists in the use of a very long chamber which is said to reduce the velocity of the liquid particles to negligible proportions, thus permitting a very thorough separation of the vapor.

ONE new device for handling solid materials appears as the ingenious Ross feeder, an English development recently introduced into this country by the Ross Screen & Feeder Company of New York. This machine was developed for use in metallurgical operations, but has seeming applications in the chemical industries wherever lump material is to be discharged from a hopper. The device is built in a number of variations but in principle consists of a hopper from which an inclined discharge chute, open on the upper side, leads to the point to which the material is to be discharged. A number of heavy chains are placed side by side in the form of continuous loops in the discharge chute, threaded at the top over an ingenious form of gear which may be rotated. As the chains are loosely rotated within the chute, the flow is controlled with surprising accuracy. It is said that the discharge weight may be controlled over a period of time within one or two per cent.

In filtering equipment two companies made new showings. The first was a device based upon a filter developed recently in Great Britain and known as the Cuno filter. It is made by the Cuno Engineering Corporation of Meriden, Conn., and employs the principle of edge or stream-line filtration, using a stack of thin metal disks placed in controlled relation to each other as a filtering medium. This medium is turned in contact with a scraper whenever the filter cake is to be discharged. The principal application of this filter at present is in connection with non-corrosive media.

In rotary filters, Oliver United Filters exhibited two modifications of previous types. One is a rotary dewaterer of the type in which hoppers are superimposed upon the filtering surface of a rotary vacuum filter. This filter has been provided with a hood for drying the filtered material and is similar to this company's salt filter. This particular machine is intended for heavy and coarsely crystalline materials such as grainer salt and metallurgical concentrates. The other new offering of this company is a new type of hood and heating system for the smaller models of salt filters and filters for crystals.

A UNIQUE machine was shown by the A. Huhn Manufacturing Company of Minneapolis. This is a drier which goes by the name of "Chinook" and was developed originally for drying starch and flour. It consists in a rotating shell through which extend a number of stationary, square tubes containing the heating medium. Air is circulated through the shell to assist in the drying. The heating medium may be steam, hot water or hot oil and the drier is intended to handle any pulverized or granular material. Its feed and discharge are continuous.

Proctor & Schwartz of Philadelphia have introduced an improved model of continuous drier for filter cake. This is used with a continuous vacuum filter which discharges into an open-mesh conveying belt onto which the cake is pressed. The belt is then carried in festoons through the drying chamber, at the end of which the cake is broken loose from the conveying belt and discharged by means of a flight conveyor. An improvement in rotary driers has been made by Struthers-Wells Company. This consists in refinement in design of carrying rolls and drive units for drier (or kiln) shells. Roller bearings have been added and the design has been simplified and made more compact.

Several innovations appeared in the field of disintegration equipment. The U. S. Colloid Mill Corporation of Long Island City showed a new model of colloid mill for small production work, known as the Junior production model. This mill is similar to the company's laboratory model except that the arrangement of motors has been changed so that one rotor is directly driven at motor speed while the other rotor is geared up to four times the speed of the first. This simplifies feed of the material to the mill. This unit also is of heavier construction than the laboratory model. The company also has announced for the first time that the rotors used in its mills are of flexible construction, consisting of a flexible web and a heavy annular grinding surface. This is said to insure perfect alignment of the rotors when the mill is in operation.

The Premier Mill Corporation of Geneva, N. Y., introduced a new 5-inch paste mill for treating of 7 to 50 gallons per hour. It is suitable for various heavy emulsions and similar products and is a duplication in smaller size of this company's larger paste mills.

Raymond Bros. Impact Pulverizer Company, Chicago, has redesigned the 0000 pulverizer. The new machine has an improved feed for close control, is mounted as a complete unit with direct motor drive and is supplied with anti-friction bearings. It is provided with a self-contained fan for removing the ground product. Still another new mill was exhibited by Vasel Grinding Mills, Inc., of Philadelphia. This is a novel type of three-roll paste mill for grinding enamels, paints and colors. Its principal feature of novelty is a hydraulic device for regulating the pressure between the rolls. The pressure may be read at a glance upon pressure gages. This feature is said to permit the instant attainment of any desired working pressure and the calibration of pressures for different classes of work.

A number of new or improved devices for mechanical separation were shown. The Orville Simpson Company of Cincinnati has introduced a new intermediate-size line of Rotex screens of the double-compensating balance-wheel type designated as series 40. The balancing system has been redesigned and simplified so that both balancing weights revolve in opposite directions on a single shaft, driven by means of spiral bevel gears.

In vibrating screens there is a new offering known as the "Jigger" made by the Productive Equipment Corporation of Chicago. This screen is of the eccentric-throw type but offers the novelty of easy adjustment of the screening angle and adjustment of the amount of eccentric throw through a wide range. Heavy flywheels mounted on the eccentric shaft practically confine the vibration to the screen itself and eliminate it from the foundations. The "Hummer" screen made by W. S. Tyler Company of Cleveland has been provided with a new mounting for the screen in model 60. This mounting prevents vibration from reaching the frame of the screen and insures uniform vibration over the entire screening surface itself.

THERE were several new presentations in mixing and agitating equipment. The Turbo-Mixer Corporation of New York has developed a new type of deflecting-blade ring for better distribution of the mixing currents. This is applied to a new change-can mixer which is a self-contained unit for portable-can work. The unit consists of a central post supporting the motor, and lowering mechanism for the turbo-mixer itself. The mixer consists of a shrouded turbine wheel rotating within a diffusing ring. The Fanner Manufacturing Company of Cleveland has developed a new line of agitators for barrels and drums. Some of these may be mounted directly in the drum by the producer of the drum's contents while others are installed at the time of use.

In kneading mixers, Baker-Perkins Company of Saginaw, Mich., has introduced a new heavy duty universal mixing and kneading machine. This is of 100 gallons working capacity and makes use of roller bearings. The mixer is known as type VI and is made in various styles, all with improved tilting mechanism. The J. H. Day Company, Cincinnati, is building a new inclosed and jacketed mixer for working under

vacuum. This machine is of unit construction with the motor mounted directly beneath the mixer.

A new factory-size distilled water unit was shown by the Barnstead Still & Sterilizer Company, Boston. This machine is of unit construction, including both the still and reservoir, and is fully automatic in operation. It is heated by steam and controlled to maintain the reservoir contents within predetermined limits.

The Pfaudler Company of Rochester exhibited a new glass lined percolator of 50 gallons capacity known as the "Pre-Vak Jr." This machine is intended for extractions of all kinds and is a modification of and slightly smaller than the previous model. The machine consists of a glass lined tank containing a perforated basket for the material to be extracted. Built as an integral part of the machine is a motor-driven circulating pump and heater for the menstruum. The design of the equipment is such that the pump maintains vacuum below the basket and pressure above.

A number of new devices for control of one sort or another were shown. A new sacking scale has been developed by the Exact Weight Scale Company of Columbus. This scale was built primarily for fertilizers but may also be used for other powdered and granular materials. It features a fully damped, magnifying pointer to enable the operator to control the weighing within ¼ pound. This scale is said to be extremely rapid in action.

A device known as the Gottfried automatic flow control, made by Baker-Perkins Company, has recently been developed for use in bakeries and is now being offered for the first time in the chemical industries. It consists of a thermostatically controlled hot and cold liquid mixer combined with a meter which may be set for any predetermined delivery. The meter automatically closes a solenoid valve and shuts off the flow at the proper delivery.

IN THE FIELD of instruments the Bristol Company, Waterbury, Conn., has developed a number of new models. This company is now offering a line of air-operated pressure and temperature control instruments. One model of pressure gage has been made in the suspended pen type and the 6-inch electrical instruments are provided with a new and smaller case. The Republic Flow Meters Company, Chicago, has developed a new completely self-contained control pyrometer. Through the use of a gas-filled, inclosed mercury switch in place of the usual open contacts, this instrument has eliminated the use of a relay for operating controlled devices. The Motometer Company, Long Island City, has added electrical contacts to some of its line of indicating thermometers so that these may be used for control purposes. The Bailey Meter Company of Cleveland has adapted the Selsyn motor to remote indication and control on various instruments.

Several other products which have been newly introduced or improved were also shown. The Carpenter Container Company of Brooklyn is offering a new line of drums made of fiber, wood and steel, combined, for products not dry and for semi-liquids. These drums are easily opened yet entirely tight for the class of products with which they may be used. The Duriron Company is now equipped to produce welded Duriron coils up to a size of about 20 sq.ft. of heating surface. These coils are composed of 2-inch I. D. Duriron pipe welded to return bends and may be made in lengths of 4 ft. in sizes up to 6 or 8 turns. The J. P. Devine Manufacturing Company has introduced a new autoclave mounted horizontally for processing dry materials. This is a heavy duty machine constructed as a unit with both autoclave and reducing gears mounted on a common base. The agitator is said to require a minimum of power.

Henry K. Davies & Company of New York has introduced a line of soft-rubber-covered equipment and piping. This makes use of bonding of the inside and outside coatings to each other through perforations in the metal used as the skeleton of the equipment, rather than bonding the rubber to the metal.

A number of new construction materials have been introduced. The General Ceramics Company has developed a white glaze for stoneware intended for such uses as pharmaceutical manufacture. The U. S. Stoneware Company has introduced a new acid-proof brick and also a new type of acid-proof cement. The silica content of the new cement is over 70 per cent and is said to be at least 10 per cent higher than in other cements. This is said to result in higher refractory properties. The cement is intended for use with all corrosives except hydrofluoric acid.

A new refractory material of the zirconium oxide type, put out under the name of "Rineheit," is being made by the Mutton Hollow Fire Brick Company of Woodbridge, N. J. This material is intended for high temperature use and is manufactured in standard brick and shapes as well as in slabs, tile and special shapes. It has a weight of approximately 3½ lb. per 100 cu.in. It is also made in the form of kiln furniture.

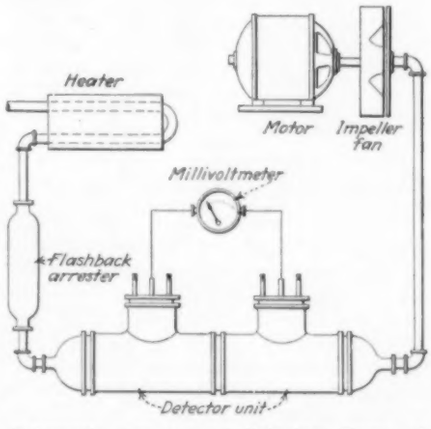
A new protective coating marketed under the name of "Rubalt" has been placed upon the market by Alfred Hague & Company of New York. This material is composed of rubber, bitumen and benzol and is said to be highly resistant to such materials as mineral acids, alkalies, chlorine, ammonia, brine and other chemical media. The material is ordinarily black although one grade is made in a number of colors. The colored grade is not in general as successful with powerful corrosive agents as the various grades of black material.

Flammable Vapor Indicator

For use as an indicator of the degree of flammability or the proximity to explosive conditions of combustible gases or vapors from solvent recovery processes, lacquering, japanning and so on, the Mine Safety Appliance Company of Pittsburgh has introduced a new instrument known as the F-M continuous flammable vapor indicator.

The drawing gives an idea of the operation of this device. The sample is led continuously to the apparatus where it passes through a small heating coil maintained at approximately the temperature of the region from which the sample was taken. This prevents the condensation of any vapors. The gas then passes through a flashback arrester and into a detector unit consisting of a tube of asbestos incasing a thermocouple. The whole is surrounded by a small electric heating coil which operates at a temperature of approximately 500 deg. F. The warm junction of the thermocouple is activitated by means of platinum which acts as a catalyst for accelerating the combustion of the gas. The combustion raises the temperature of the gases and is indicated by the thermocouple, connected to a millivoltmeter.

The degree of increase in temperature is proportional to the amount of flammable vapor present. The meter readings therefore give a direct indication of the percentage of an explosive mixture in the sample under test. The manufacturers point out that through the use of this apparatus it is possible to minimize the danger of explosion, at the same time providing adequate but not uneconomical ventilation.



Schematic Drawing of Principal Parts of Flammable Vapor Indicator

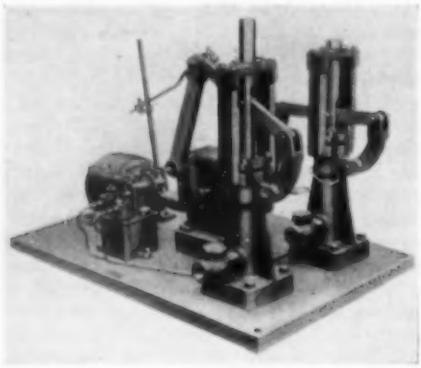
New Belt Feeder

For unloading any hopper-bottom car of bulk material, the Barber-Greene Company, Aurora, Ill., has introduced the new B-G belt feeder. The purpose of the machine is to eliminate the necessity for constructing a pit under railroad tracks. The feeder consists of a horizontal belt conveyor of maximum thickness 4½ in. It may be installed

beneath the rails or may be put in place above the rails after a car has been spotted. The feeder is intended to unload in conjunction with any form of loader or stacker. It is adapted either to electric-motor or gasoline-engine drive.

Improved Proportioning Pump

The Hills-McCanna Company of Chicago has recently announced a new and improved "L" type proportioning pump in which the plunger is guided to eliminate all possibility of distortion



Two-Plunger "L" Type Proportioning Pump

when operating under high pressure. The assembly illustrated was designed especially for pumping sulphuric acid in metered quantities. This pair of pumps will handle capacities ranging from 5 to 60 gal. per hour against pressures up to 400 pounds.

Wind-Up Tension Control

A recent adaptation of the torque amplifier principle which was developed by the Bethlehem Steel Company, Bethlehem, Pa., and described in *Chem. & Met.* for July, 1927, is a reel drive and tension control. This is intended for use in all such applications as the winding up of paper, rubberized fabrics, textiles and similar materials, where it is desirable to put a definite tension upon the wind-up and maintain this tension constant as the diameter increases.

Both drive and tension depend upon frictional action, and the device is compensated for change in the coefficient of friction so as to insure a uniform drag. The drag is controlled by a roller resting upon the material. This moves as the material builds up or is taken from the reel with the result that the linear pull on the web is kept constant for all diameters. Other systems of varying the tension may also be used. In addition, there is an adjustment incorporated in the mechanism, calibrated so as to make any desired magnitude of the tension immediately obtainable.

The device is said to maintain a positively uniform tension in an entirely automatic manner. At the same time tension is readily adjustable and may be corrected while the reel is running.

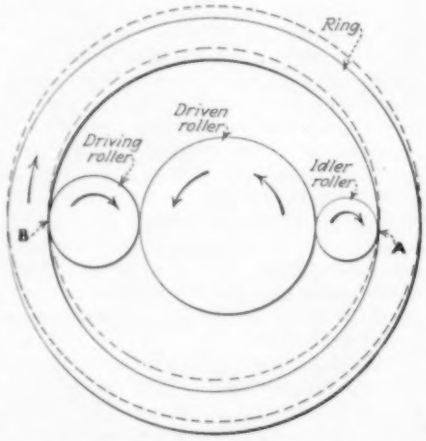
Novel Speed Changers

Two series of fixed-ratio speed changers of a distinctly novel type have recently been placed upon the market by Crocker-Wheeler Electric Manufacturing Company, Ampere, N. J. These changers are made under the Garrard patents which are understood to have been considerably used in England.

The so-called Type C changer consists essentially of four parts, shown in the accompanying sketch. Within a ring of rectangular cross section are three rollers, a driving roller, a driven roller and an idler. These rollers are maintained in line and forced into the ring, the inside diameter of which is slightly less than the sum of the diameters of the rollers. It is evident that the pressure necessary to transmit the torque between the driving and driven roller is supplied by the ring and not by the bearings of the machine.

It will be noted that the ring rotates with the rollers. If an overload should be applied to the gear, the action is as follows: Assume that the driven roller is momentarily held from rotating. Then, since there is no force to rotate the idler roller, the point of contact "A" remains fixed. When the load becomes great enough to cause the driving roller to slip on the driven roller, the ring at "B" is carried slightly upward by the driving roller to some such position as is shown by the dotted line, where the increase in grip of the ring is enough to cause the driven roller to revolve and hence transmit the load without slip. It is evident that this system automatically adjusts the pressure according to the load.

Another type of gear, known as Model "S," is somewhat similar in principle, although its working out is considerably different. In this case, three or more planetary rollers, carried in a cage, rotate within two pressure rings, and about a central shaft. The shape of the rollers is such, and the shape and support of the pressure ring so designed, that any increase in load tends to increase the pressure with which the rings bear upon the rollers. The central shaft constitutes one side and the rollers and cage the other side of the power system.



Illustrating the Principle of the Type C Speed Changer

In each type of speed changer, it is possible to apply these principles either to a speed increaser or speed reducer. Model C is available as a reducer in ratios between 1¼ to 1 and 10 to 1. As an increaser, ratios may be had between 1 to 1¼ and 1 to 4. Model "S" is manufactured with ratios between 3 to 1 and 10 to 1 and vice versa, for reducers and increasers respectively.

These new speed changers are said to offer long life, low friction losses and quiet action at high speeds. The manufacturers claim to have solved the problem of lubrication while obviating the possibility of slippage even at excessively high overloads.

Safety Push Button

A new push button for which special safety features are claimed has been announced recently by the Lincoln Electric Company, Cleveland, Ohio. The illustration clearly shows that the "Start" button is contained inside a large cup-shaped "Stop" button. The "Stop" button therefore protects the "Start" button from accidental contact. It is necessary to insert the tip of the thumb or finger into the cup shaped element in order to start the appliance with which this switch is used.

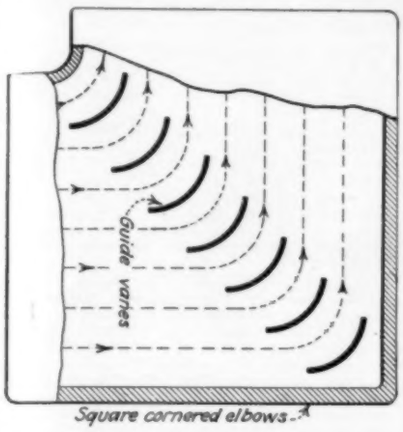
New Safety Type Push Button

New Elbow Design

Recent work at the General Electric Company has shown the remarkable fact that, in many cases, the resistance of square cornered bends in ducts is less than the resistance of a rounded bend. The reason for this is that the turbulence in an ordinary elbow, at points where the jet tends to strike the flatter portions of the curve, seriously reduces the effective cross sectional area of the elbow. In square elbows, however, most of the turbulence takes place in the corner with less effect upon the flow area. It was found at the same time that a number of small guide vanes placed across the diagonal of a square elbow still further increased the efficiency of the bend. The Connery Company of Philadelphia has

acted upon these results and made available a square elbow employing these improvements. This type of bend is illustrated in the accompanying sketch.

The blades are attached to give minimum turbulence and reduction in flow



Use of Square Elbow and Guide Vanes Increases the Efficiency of This Bend

area. Since the blade area is small compared with the duct dimensions, the surface friction is but slightly increased. The net result is that the elbow efficiency is improved more than 10 per cent.

Manufacturers' Latest Publications

Activated Carbon. Industrial Chemical Sales Company, New York Central Bldg., New York, N. Y.—Two bulletins, one describing activated carbon in the decolorizing, deodorizing and purifying of oils, fats and greases and the other describing solvent recovery and purification with "Nuchar."

Air Filters. Midwest Air Filters, Inc., Bradford, Pa. — Booklet entitled "Man's Conquest of the Air," a technical discussion of the centrifugal cleaning of air with particular reference to the sinuous type filter.

Apparatus. The Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.—Describes L. & N. conductivity controllers.

Apparatus. National Board of Fire Underwriters, 207 East Ohio St., Chicago, Ill.—Publications supplementing the July, 1928, list of inspected gas, oil and miscellaneous appliances; also inspected fire protection appliances; also list of burglary protection appliances.

Apparatus. The Palo Co., 153 W. 23rd St., New York, N. Y.—Bulletin on miscellaneous laboratory equipment.

Bearings. The Timken Roller Bearing Company, Canton, Ohio.—New 149-page book, nicely bound, on the subject of "Wherever Wheels and Shafts Turn." Approximately two-thirds of the book is devoted to various uses of Timken bearings and one-third to engineering service, design and bearing data.

Buildings. New Jersey Zinc Sales Company, 160 Front St., New York, N. Y.—Bulletin 12C4—Information and data on "Zilloy," a zinc alloy made in the form of corrugated roofing and siding.

Centrifugals. Laughlin Filter Company, c/o Lidgerwood Mfg. Company, Elizabeth, N. J.—Folio SB 1929—Booklet describing the solid bowl and screen type continuous centrifuges made by this company.

Chemicals. Solvay Sales Corporation, 40 Rector St., New York, N. Y.—Book containing data and information on alkalis and other chemicals made by this company. 44 pages.

Coatings. Semet-Solvay Company, 61 Broadway, New York, N. Y.—Booklet entitled "I Witnesses," a discussion of protective coatings as viewed by two hypothetical, animate I beams.

Compressors. Sullivan Machinery Company, 400 No. Michigan Ave., Chicago, Ill.—Bulletin No. 83-L—Describes the use of direct connected Diesel engines with Sullivan angle compound air compressors.

Condensers. Chicago Pneumatic Tool Company, 6 E. 44th St., New York, N. Y.—Catalog 718—Describes the Chicago-Byermetric condenser very completely. This is a special type of barometric condenser.

Construction Materials. Philadelphia-Quartz Company, 121 So. Third St., Philadelphia, Pa.—Bulletin on silicate curing of concrete.

Disintegration. Pulverizing Machinery Company, 30 Church St., New York, N. Y. —Bulletin describing the "Mikro-Pulverizer," a novel type of hammer mill.

Electrical Equipment. Century Electric Company, St. Louis, Mo.—Bulletins 17-2 to -6—Describing various types of fans.

Electric Equipment. Crouse-Hinds Company, Syracuse, N. Y.—Bulletins 2121 and 2129—These describe respectively "Arktite" circuit breaking plugs and receptacles, and vaporproof industrial fixtures.

Electrical Equipment. Driver-Harris Company, Harrison, N. J.—Bulletin R-228—Gives data and specifications pertaining to alloys for electrical resistance.

Electrical Equipment. Electric Controller & Manufacturing Company, Cleveland, Ohio.—Bulletin 960—Type V dinkey controller; Bulletin 1004-A, type WB brakes; Bulletin 1035, Youngstown safety limit stops; Bulletin 1100, altitude and pressure regulators and cushion tanks.

Electrical Equipment. General Electric Company, Schenectady, N. Y.—1928 Annual Report. Also publications as follows: GEA-37-D, Direct-Heat Electric Furnaces; GEA-67A, CR-2931 Float Switches; GEC-81, GE Industrial Heating Devices; GEA-98A, Adjustable Varying Speed Motors, Type BSR; GEA-161D, Novalux Floodlighting Projectors; GEA-181A, A.C. Enclosed Magnetic Switches; GEA-212A, Type CD Air Circuit Breakers; GEA-302A, GE Squirrel Cage Motors for Sugar Centrifugals; GEA-517B, Totally Enclosed Fan Cooled D.C. Motors, Type CD; GEA-588B, GE. Centrifugal Compressors, Geared Units; GEA-594A, Automatic Control Panels for Industrial Electric Heating; GEA-750A, Induction Frequency Converters; GEA-788A, Type FT Normal-Starting-Torque General Purpose Squirrel Cage Motors; GEA-801A, Tempering Baths Electrically Heated; GEA-926A, Station Oil Circuit Breakers; GEA-961A, Helicoil Resistor Units; GEA-966A, Type MI-1 Metal Clad Switch Gear; GEA-991, Insulating Material for Railway and Industrial Haulage; GEA-1067 Line Material; GEA-1095 Ground Clamps for Outdoor Stations; GEA-1102, Electric Heating Equipment for Hot Galvanizing Tanks; GEA-1106, CR-7006-F1 Magnetic Switch; GEA-1114, Solenoid Operated Valves; GEA-1115, GE Electric Furnace for Vitreous Enameling.

Electrical Equipment. National Electrical Manufacturers' Association, 420 Lexington Ave., New York, N. Y. — NEMA Handbook of Apparatus Standards, 17th edition, 348 pages, price $3.00.

Electrical Equipment. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.—Bulletins 162, 163 and 164.—Containing respectively information on transformer oil, small rubber mounted motors for ultra-quiet operation, and transformer performance.

Equipment. Alsop Engineering Company, 27 W. 63rd St., New York, N. Y.—Folder showing portable electric mixers, a glass lined electric mixing tank, filters, and mixers.

Equipment. Cameron Machine Company, Brooklyn, N. Y.—Bulletin 2-29C.D.—"How Good Rolls of Paper and Paperboard Can Be Made at the Least Expense," a review of the principles used in the slitters and roll winders made by this company.

Equipment. Kewaunee Mfg. Company, Adrian, Mich.—A.I.A. File No. 36.—Catalog of office and drafting room furnishings.

Equipment. Laboratory Furniture Company, 529 48th Ave., Long Island City, New York.—New catalog entitled "Fume Hoods."

Equipment. Paterson Foundry & Machine Company, East Liverpool, Ohio.—Catalog 105—Book describing agitators and mixers made by this company.

Equipment. A. O. Smith Corporation, Milwaukee, Wis.—Bulletins 501 and 506.—Both describe tests of, and products made by, Smithwelding. The former contains a considerable amount of engineering information.

Equipment. Universal Fixture Corporation, 135 W. 23rd St., New York, N. Y.—Folder No. 1296—Describes unit system steel shelving and cabinets for storage.

Furnaces. Ajax Electrothermic Corporation, Ajax Park, Trenton, N. J.—Bulletin 4a—Describes a 3-kva. high frequency electric furnace and a 3-kva. converter.

Glass. Mississippi Glass Company, 220 Fifth Ave., New York, N. Y.—A.I.A. File No. 26a3-5-6—64-page catalog of the various types of window glass made by this company, describing also the plant.

Instruments. The Bristol Company, Waterbury, Conn.—Bulletin 367.—Describing equipment for automatic control of chrominum plating baths; catalog 2000, automatic electric control valves for all purposes.

Instruments. Brown Instrument Company, Wayne and Roberts Aves., Philadelphia, Pa.—Book entitled "Power Plant Instrument and Data Book," containing 105 applications of instruments in steam power plants.

Instruments. Esterline-Angus Company, Indianapolis, Ind.—Bulletins 229 and 329—Discussing use of Esterline-Angus instruments and power factor correction.

Instruments. Gray Instrument Company, 64 W. Johnson St., Philadelphia, Pa.—Bulletin E-4—Catalog of potentiometers and accessory instruments.

Instruments. Thyle Machinery Company, 514 Bryant St., San Francisco, Calif.—Folder describing the Thyle automatic controller for pulp density.

Material Handling. Cleveland Crane & Engineering Company, Wickliffe, Ohio. — Folder called "Keep Your Product Moving." Also forms TR-561, two fundamental principles for handling materials; TR-4229, overhead materials-handling systems; TR-4329, paper handling. Also form MC-129, handling in metal cleaning.

Material Handling. Lewis-Shepard Company, Watertown Station, Boston, Mass.—Lift truck and stacker editions of "Jacklift and Stacker Practice," thoroughly illustrated folders describing the uses of these types of equipment.

Power Generation. Chicago Pneumatic Tool Company, 6 E. 44th St., New York, N. Y.—Bulletin 775—Completely describes type RH-75 Diesel engines.

Power Transmission. W. A. Jones Foundry & Machine Company, Chicago, Ill.—Catalog No. 42—Large general catalog on all the products of this company consisting of speed reducers, cut gears, pulleys and general power transmission machinery.

Power Transmission. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill.—Booklet No. 1167—Showing detailed specifications of sprocket wheels carried in stock.

Pumps. Hills-McCanna Company, 2349 Nelson St., Chicago, Ill.—Leaflet describing proportioning pumps.

Refractories. North American Refractories Company, Curwensville, Pa.—Technical Bulletins Nos. 21 and 22—Discussing respectively heat penetration in refractories and an elementary account of the softening of refractories by heat.

Refractories. Quigley Furnace Specialties Company, 56 W. 45th St., New York, N. Y.—Bulletin 252—Completely describes "Hytempite," a cement for high temperature service.

Separators. Griscom-Russell Company, 285 Madison Ave., New York, N. Y.—Form 453—Describes the Bundy oil separator for steam, natural and casinghead gas.

Steam Generation. Combustion Engineering Company, 200 Madison Ave., New York, N. Y.—Booklet MR-1 and catalog K-2—Describing respectively multiple retort stokers and type K center retort underfeed stokers.

Steam Generation. Foster Wheeler Corporation, 165 Broadway, New York, N. Y.—Bulletin 37—52 pages describing the "Aero" unit system for firing pulverized fuel.

Stoneware. U. S. Stoneware Company, Akron, Ohio.—Bulletins 102, 202, 303—Describing respectively stoneware developing tanks, tanks for engraving and X-ray developing tanks.

Valves. Schutte-Koerting Company, Philadelphia, Pa.—Bulletin 8T—describes seatless valves.

Valve Control. The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. —Publication DE-1—concerns the remote control of valves in many installations by means of electrically operated valve operating units.

Welding. The Linde Air Products Company, 30 East 42nd St., New York, N. Y.—Bulletin J 740—"Oxwelding Pressure Vessels," a reprint from *Oxy-Acetylene Tips.*

Welding. Metropolitan Life Insurance Company, New York, N. Y.—Booklet entitled "Safety in Welding," devoted to the overcoming of health and accident hazards in welding operations.

Welding. Oxweld Acetylene Company, 30 E. 42nd St., New York, N. Y.—Booklet on high-test welding rod, describing in detail the rod itself and its use.

Water Softening. The Graver Corporation, East Chicago, Ind.—Bulletin 5049—Describes the hot process of water softening.

PATENTS ISSUED
March 5 to April 30, 1929

Paper, Pulp, Glass and Sugar

Method of and Apparatus for Manufacturing Paper. John Traquair, Chillicothe, Ohio, assignor to Mead Pulp & Paper Company, Dayton, Ohio.—1,707,333.

Method of and Apparatus for Forming a Web in Paper Making. Anton J. Haug, Nashua, N. H.—1,708,724.

Paper and Process of Making the Same. Lester Kirschbraun, Chicago, Ill., and Albert L. Clapp, Danvers, Mass.; said Clapp assignor to Flintkote Company, Boston, Mass.—1,708,926.

Process of Producing Dextrose. Raymond E. Daly, Homewood, Ill., assignor to American Maize-Products Company, Roby, Ind.—1,708,940.

Paper-Making Machine. Adam E. Bridge, Franklin, Ohio, assignor to Black-Clawson Company, Hamilton, Ohio.—1,709,112.

Means for Preparing Pulp in Paper Making. Fay Kerr, Averyville, Ill., and Max Zimmerman, Lockport, N. Y.—1,709,133.

Rails for Fourdrinier Paper-Making Machines. Albert H. Standley and George C. Kilberry, Downingtown, Pa., assignors, by mesne assignments, to Beloit Iron Works, Beloit, Wis.—1,709,754.

Recovery of Valuable Products from Spent Sulphite Liquors. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,710,272.

Method and Apparatus for Making Paper. Gaston Amedee Mouriaque, Paris, France.—1,710,375.

Cutting and Measuring Apparatus for Sheet Glass. Clifford A. Rowley, Toledo, Ohio, assignor to Libbey-Owens Sheet Glass Company, Toledo, Ohio.—1,710,898.

Process of Treating Hemp Waste. Canning C. Beeth, Duluth, Minn.—1,710,914.

Manufacture of Dextrose. Charles Ebert, Leonia, N. J.; William B. Newkirk, Riverside, Ill.; and Meyer Moskowitz, Spring Valley, N. Y., assignors to International Patents Development Company, Wilmington, Del.—1,704,037.

Paper-Making Method and Apparatus. Judson A. De Cew, New York, N. Y.—1,704,728.

Process for the Production of Cellulose by Decomposition of Vegetable Fibers. Otto Carl Strecker, Darmstadt, Germany.—1,705,424.

Method of Pulping Wood. Francis G. Rawling, Madison, Wis.—1,705,827.

Bleaching of Pulp. Linn Bradley, Montclair, N. J., and Edward P. McKeefe, New York, N. Y.—1,705,897.

Rubber, Rayon and Synthetic Plastics

Process of Vulcanizing Rubber and Product Therefrom. Winfeld Scott, Akron, Ohio, assignor to The Rubber Service Laboratories Company, Akron, Ohio.—1,703,902.

Condensation Products of Formalde-Hyde and Urea and Process of making the same. Leonard Smidth, Brooklyn, N. Y., assignor to Edward G. Budd Manufacturing Company, Philadelphia, Pa.—1,704,347-8.

Mixed Organic Esters of Cellulose and Process of Making the Same. Hans T. Clarke, New York, and Carl J. Malm, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y.—1,704,282-3.

Process of Making Cellulose Ethers. Helene Sessler, Mannheim, Germany, assignor to C. F. Boehringer & Soehne G. m. b. H., Mannheim-Waldhof, Germany.—1,704,304.

Delustering of Artificial-Silk Fibers or Rayon. Oscar F. Muller, Montclair, N. J., assignor to Nyanza Color & Chemical Co., Inc., New York, N. Y.—1,705,490.

Synthetic Resin Composition of the Phenol-Furfural Type. Emil E. Novotny, Logan, Pa., and Donald S. Kendall, Little Falls, N. J., assignors to John Stogdell Stokes, Huntingdon Valley Post Office, Pa.—1,705,493-6.

Method of Preparing Coumaron-in-Dene Resins. Ralph L. Emery, Coraopolis, Pa. assignor to Neville Chemical Company, Neville Island, Pa.—1,705,857.

Process for Vulcanizing Rubber and Product Obtained Thereby. Morris L. Weiss, Newark, N. J., assignor to Dovan Chemical Corporation, New York, N. Y.—1,705,948.

Condensation Product from P-Halo-Genated Phenolic Compounds and Aldehydes. Max Weiler, Wiesdorf, and Berthold Wenk and Hermann Stötter, Leverkusen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,707,181.

Phenol-Acetylene Resin. Howard W. Matheson, Montreal, Quebec, Canada, and Julius A. Nieuwland, Notre Dame, Ind., assignors to Canadian Electro Products Company, Limited, Montreal, Quebec.—1,707,940-1.

Process of Manufacturing Esters and other valuable organic compounds. Fred C. Zeisberg, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,708,460.

Manufacture of Fatty Acid Esters of Cellulose of High Viscosity. Henry Dreyfus, London, England.—1,708,787.

Process of Esterifying Aldehydes. Jacques Schalach and John W. Olson, Chicago, Ill., assignors to Van Schaack Bros. Chemical Works, Inc., Chicago, Ill.—1,708,-902.

Method of and Apparatus for Drying Cellulose Tubing. Clarence E. Coleman and Harold F. Whittaker, Buffalo, N. Y., and Thomas E. Sharpe, Old Hickory, Tenn., assignors to Du Pont Cellophane Company, Inc.—1,708,937.

Moldable Composition and Method of Making Same. Herbert A. Winkelmann, Akron, Ohio, assignor to Philadelphia Rubber Works Company, Akron, Ohio.—1,709,-241-2.

Treatment of Cellulose Acetate Artificial Silk. Archibald John Hall, Timbersbrook, Congleton, England, assignor to Celanese Corporation of America.—1,709,470.

Mixed Ester Resin Complex and Method of Producing the Same. Israel Rosenblum, Jackson Heights, N. Y., assignor to Varnol Chemical Corporation, Long Island City, N. Y.—1,709,490.

Process of Forming Cellulose Products. Harry P. Bassett, Cynthiana, Ky., and Thomas F. Banigan, Philadelphia, Pa., assignors to Meigs, Bassett & Slaughter, Inc., Philadelphia, Pa.—1,709,513.

Process of Produciog Transparent, Hard, Insoluble, and Infusible Products of Condensation from Phenols and Aldehydes. Leonard Deutsch and Isak Thorn, Vienna, Austria, assignors to Selden Company, Pittsburgh, Pa.—1,710,019.

Cellulose-Nitrate Plastic. George L. Schwartz, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,710,078.

Process for the Preparation of Resins. Mellach Melamid, Freiburg, Germany, assignor to Canadian Electro Products Company, Limited, Montreal, Canada.—1,710,-266.

Petroleum Products and Processing

Process for the Conversion of Petroleum Oils. Gustav Egloff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,707,348-9.

Fractional Distillation. John Primrose, Richmond, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y.—1,707,369.

Process of Distilling Mineral Oil. Arthur E. Pew, Jr., Bryn Mawr, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,707,448.

Method of and Means for Treating Fluid Hydrocarbons. Frank B. Fretter, Cleveland, Ohio, assignor to National Refining Company, Cleveland, Ohio.—1,707,606.

Process of Cracking Petroleum Hydrocarbons. Charles Raymond Downs, New Haven, Conn., assignor to Weiss & Downs, Inc., New York, N. Y.—1,708,303.

Process of Purifying Petroleum Oils. John C. Black, Destrehan, La., and Wirt D. Rial and Raymond T. Howes, Wilmington, Calif., assignors to Pan American Petroleum Company, Los Angeles, Calif.—1,709,203.

Treating Hydrocarbon Oils. Otto Behimer, Port Arthur, Tex., assignor, by mesne assignments, to Texas Company, New York, N. Y.—1,709,302.

Treating Hydrocarbon Oils. Guy B. Bogart, Lockport, Ill., assignor, by mesne assignments, to Texas Company, New York, N. Y.—1,709,304.

Distillation of Oils. Albert G. Peterkin, Jr., Bryn Mawr, and William F. Stroud, Jr., Cynwyd, and Richard B. Chillas, Jr., Philadelphia, Pa., assignors to Atlantic Refining Company, Philadelphia, Pa.—1,709,874.

Process for Treating Hydrocarbon Oil. Jacque C. Morrell, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,710,063.

Process for Fractionally Distilling Hydrocarbons. Robert T. Pollock, Boston, Mass., assignor to Universal Oil Products Company, Chicago, Ill.—1,710,068.

Process of Treating Hydrocarbons. John C. Black and Marvin L. Chappell, Los Angeles, Calif., assignors to Pan American Petroleum Company, Los Angeles, Calif.—1,710,143.

Process and Apparatus for Treating Hydrocarbons. Gustav Egloff, Independence, Kans., assignor to Universal Oil Products Company, Chicago, Ill.—1,710,152-5.

Process for Treating Hydrocarbon Oils. John C. Black and Marvin L. Chappell, Los Angeles, Calif., assignors to Pan American Petroleum Company, Los Angeles, Calif.—1,710,200-1.

Distillation of Lubricating Stock. Albert G. Peterkin, Jr., Bryn Mawr, William F. Stroud, Jr., Cynwyd, and Richard B. Chillas, Jr., Philadelphia, Pa., assignors to Atlantic Refining Company, Philadelphia, Pa.—1,710,240.

Art of Distilling Oils. Edgar M. Clark, New York, N. Y., and Frank A. Howard, Elizabeth, N. J., assignors to Standard Oil Development Company.—1,710,404.

Purification of Tar-Acid-Bearing Oils. Solomon Caplan, Brooklyn, N. Y., assignor to Combustion Utilities Corporation, New York, N. Y.—1,710,764.

Art of Cracking Hydrocarbons. Edward W. Isom, Scarsdale, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,711,351.

Treatment of Distillates from Processes of Cracking Petroleum Oils. Ralph A. Halloran, Berkeley, Calif., assignor, by mesne assignments, to Universal Oil Products Company, Chicago, Ill.—1,704,246.

Process of Treating Petroleum Oils. John C. Black, Los Angeles, Calif., assignor to Pan American Petroleum Company, Los Angeles, Calif.—1,704,588.

Process for Treating Oil Shale. Milton J. Trumble, Los Angeles, Calif.—1,704,956.

Art of Cracking Hydrocarbons. George H. Taber, Jr., Rye, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,705,077.

Process for Treating Carbon from Cracking Stills. Gustav Egloff and Harry P. Benner, Independence, Kan., assignors to Universal Oil Products Company, Chicago, Ill.—1,705,179.

Process for the Catalytic Treatment of Hydrocarbon Oil. Gustav Egloff and Jacque C. Morrell, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,705,180-81.

Process of Treating Residual Oils. Jacque C. Morrell, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,705,199.

Process of Combining Natural Gas and Hydrocarbon Oil for the Production of Gasoline. Lester S. Worthington, Casper, Wyo., assignor to C. L. Thompson, Casper, Wyo.—1,705,348.

Process of Removing Sulphur Compounds from Petroleum Oils. William N. Davis, Oakland, William H. Hampton, Berkeley, and Edwin N. Klemgard, Albany, Calif., assignors, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,705,809.

Removal of Wax from Hydrocarbon Oils. Robert S. Lane, Wood River, Ill., assignor to Standard Oil Company, Whiting, Ind.—1,706,120.

Process and Apparatus for the Treatment of Hydrocarbons. John C. Black, Destrehan, La., assignor, by mesne assignments, to Gasoline Products Company, Inc., Wilmington, Del.—1,706,396.

Method of Cracking Oils. John R. Mardick, New York, N. Y., assignor to Universal Oil Products Company, Chicago, Ill.—1,706,629.

Motor Fuel and Process of Making Same. Lester Kirschbraun, Evanston, Ill., and Charles B. Belknap, Highland Park, Mich.—1,707,019.

Coal Processing and Combustion

Apparatus for the Distillation or Heat Treatment of Carbonaceous or Other Materials. Frederick Deacon Marshall, Weybridge, England.—1,704,092-4.

Apparatus for Carbonizing Coal. Richard Lee Rodgers, Chicago, Ill., assignor, by mesne assignments, to Charcolite Corporation, Clinton, Ind.—1,704,103.

Coke-Oven-Valve Construction. Nathaniel G. Parry, Pittsburgh, Pa., assignor

to The Koppers Company, Pittsburgh, Pa.—1,704,209.

Fuel-Gas-Distributing System for Coke Ovens. Joseph Becker, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,704,239.

Process and Apparatus for Splitting Coal, Oils, and Other Hydrocarbons. Arno Debo, Mannheim-Rheinau, Germany, assignor to Internationale Bergin-Compagnie voor Olie en Kolen-Chemie, The Hague, Netherlands.—1,704,792.

Regenerative Heating Apparatus. Joseph van Ackeren, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,704,685-7.

Coke Treatment and Product. Allison A. Kohr, Maplewood, N. J., assignor to The Koppers Company, Pittsburgh, Pa.—1,705,020.

Coke Oven. August Putsch, Wanne, Germany, assignor to The Koppers Company, Pittsburgh, Pa.—1,705,029.

Coking Retort Oven. Joseph van Ackeren, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,705,841.

Apparatus for Distilling Materials. Walter Edwin Trent, Washington, D. C., assignor to Trent Process Corporation, New York, N. Y.—1,706,421.

Coking Retort Oven. Joseph Becker, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,706,476.

Apparatus for Cooling and Purifying Gases. Francis Glanville Inglis, Linthorpe, Middlesbrough, England.—1,707,163.

Coking Retort Oven. Joseph Van Ackeren, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,707,419.

Art of Coking Coal in a Retorting Space. Joseph Becker, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,707,427.

Method of Gas Production. Charles W. Andrews, Duluth, Minn., and Herman A. Brassert, Chicago, Ill.—1,707,651.

Retort Oven. Heinrich Koppers, Essen-Ruhr, Germany, assignor to Koppers Development Corporation, Pittsburgh, Pa.—1,707,734.

Gas Producer. Charles W. Lummis, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass.—1,707,811.

Manufacture of Agents for Emulsifying, Purifying, Wetting, or the Like by Sulphonation. Karl Marx, Karl Brodersen, and Karl Bittner, Dessau, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,708,103.

Process for Low-Temperature Distillation of Bituminous Coal. Gabriel E. Rohmer, New York, N. Y., assignor to National Coal Distillation Corporation.—1,708,740.

Process for the Separation of Low-Temperature Tar into Phenols and Hydrocarbons. Adolf Correll, Essen-Ruhr, Germany, assignor to Zeche Mathias Stinnes, Essen-Ruhr, Germany.—1,709,309.

Method of Generating Gas. Charles W. Andrews, Duluth, Minn., and William B. Chapman, Jackson Heights, N. Y., assignors of one-half to H. A. Brassert & Company, and one-half to Western Gas Construction Company.—1,709,335.

Apparatus for Distillation. Emil Piron, New York, and Virginius Z. Caracristi, Bronxville, N. Y., assignors to Piron Coal Distillation Systems, Inc., New York, N. Y. 1,708,370-1.

Process of Working Down the Products Arising When Coal Is Liquefied by Hydrogenation. Karl Schoenemann, Mannheim-Rheinau, Germany.—1,709,957.

Coking Process and Apparatus Therefor. Louis Wilputte, New Rochelle, N. Y., assignor, by direct and mesne assignments, to Wilputte Coke Oven Corporation, New York, N. Y.—1,710,464.

Organic Processes

Process and Apparatus for Thermally Decomposing Hydrocarbons. Stanley M. Norwood, Flushing, N. Y., assignor to Electro Metallurgical Company.—1,703,949.

Apparatus for the Continuous Manufacture of Absolute Alcohol. Eloi Ricard, Melle, France, assignor, by mesne assignments, to U. S. Industrial Alcohol Co., New York, N. Y.—1,704,213.

Manufacture of Ammonium Benboate. Joseph A. Spina, Niagara Falls, N. Y., assignor to Hooker Electrochemical Company, New York, N. Y.—1,704,636.

Separation of Compounds from Mixtures of Oxygen-Containing Organic Compounds. Martin Luther, Mannheim, and Hermann Jochheim, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,704,751.

Process for the Production of Acetic Acid. Henry Dreyfus, London, England.—1,704,965.

Process of Producing Tetra-Ethyl Lead. Herbert W. Daudt, Penns Grove, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,705,723.

Process and Catalyst for the Synthesis of Methanol. Henry Herman Storch, New York, N. Y., assignor to Roessler & Hasslacher Chemical Company, New York, N. Y.—1,707,331.

Method of Making Ethylene Glycol. Edgar C. Britton, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,709,605.

Alcohol and Method of Producing the Same. Joaquin Julio de la Roza, Sr., Brooklyn, N. Y., assignor to Bagasse Products Corporation, New York, N. Y.—1,709,610.

Process for the Activation of Carbon. Julius Drucker, Cologne-on-the-Rhine, and Heinz Thienemann, Leverkusen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,709,611.

Catalytic Oxidation of Organic Compounds. Alphons O. Jaeger, Crafton, Pa., assignor to The Selden Company, Pittsburgh, Pa.—1,709,853.

Method of Recovering Sulphur from Carbonyl Sulphide. Raymond C. Benner, Niagara Falls, and Alfred Paul Thompson, Jackson Heights, N. Y., assignors to General Chemical Company, New York, N. Y.—1,710,141.

Process for the Manufacture of Soft Soap. Louis Georg Leffer, Kapellen, near Neuss Rhineland, Germany, assignor to Hermann Bachstein, Berlin, Germany.—1,710,799.

Process of Treating Benzol to Eliminate Corrosive Properties. Theodore R. Trainor, Wilson, Pa., assignor of one-half to Joseph A. Kelly, Pittsburgh, Pa.—1,711,367.

Process for the Separation of Gases. Joseph Reilly, Cork, Ireland, and Ethelbert William Blair, Parkstone, England, assignors to Commercial Solvents Corporation, New York, N. Y.—1,706,707.

Inorganic Processes

Synthetic Production of Bodies from Their Component Gases. Ralph S. Richardson, Teaneck, N. J., assignors to Nitrogen Engineering Corporation, New York, N. Y.—1,704,214.

Process for Preparing Fertilizers. Fritz Rothe, Aachen, and Hans Brenek, Porz, near Cologne, Germany, assignors to the Firm; Rhenania Verein Chemischer Fabriken A. G., Cologne, Germany.—1,704,218.

Process for Making Alkali-Metal Xanthates. Wilhelm Hirschkind, Antioch, Calif., assignor to Great Western Electro Chemical Co., San Francisco, Calif.—1,704,249.

Plastic Light Aluminum Alloy and process of Producing Same. Victor Noak Hybinette, Jackson, Mich., assignor to Hybinette Patents Corporation, Jackson, Mich.—1,704,253.

Manufacture of Alkali of High Concentration. Franz Bencker, Cologne-Muhlheim, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,704,909.

Process of Producing Zinc. Conrad Matzel, Magdeburg, Germany, assignor to the Firm Fried. Krupp Grusonwerk Aktiengesellschaft, Magdeburg-Buckau, Germany.—1,705,128.

High-Explosive Composition. Fredrich Olsen, Dover, N. J.—1,705,874.

Electrolytic Deposition of Chromium. Rudolf Auerbach, Probstdeuben, near Leipzig, Germany, assignor to Chromeplate, Inc., Union City, N. J.—1,705,954.

Process of Oxidizing Ammonia. Clark W. Davis, Swarthmore, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,706,055.

Process for Production of Nonhygroscopic Phosphates and the Resulting Product. Henry Blumenberg, Jr., Los Angeles, Calif., assignor to Stockholders Syndicate, Los Angeles, Calif.—1,706,101.

Process for the Purification of Solutions of Metal Salts. Albert Vohl and Wilhelm Wachtendorf, Gottingen, Germany.—1,760 196.

Process for the Manufacture of White-Lead Pigment. Sydney Wilmer Kendall.—1,706,301.

Anticorrosive Material. Maximilian Toch, New York, N. Y., assignor to Standard Varnish Works, New York, N. Y., a Corporation of New York.—1,706,333.

Blasting Explosive. Leavitt N. Bent, Holly Oak, Del., assignor to Hercules Powder Company, Wilmington, Del.—1,706,517.

Process for the Manufacture of Titanium Oxide. Joseph Blumenfeld, Serquigny, France, assignor to Commercial Pigments Corporation, New York, N. Y.—1,707,248.

Synthetic Production of Ammonia. Ralph S. Richardson, Teaneck, N. J., assignor to Nitrogen Engineering Corporation, New York, N. Y.—1,707,417.

Method of Recovering Iodine. John W. Turrentine, Washington, D. C.—1,708,287.

Method of Preparing Epsom Salts. Sheldon B. Heath, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,709,398.

Process of Producing Aluminum. Julius Weber, Neuhausen, and Hans Hauser, Wilchingen, Switzerland, assignors to Aluminum Industrie Aktiengesellschaft, Neuhausen, Switzerland.—1,709,759.

Method of Producing Lithopone. William J. O'Brien, Baltimore, Md.—1,709,999.

Process for Manufacturing Sodium Bicarbonate and Ammonium Chloride. Wilhelm Gluud and Bernhard Lopmann, Dortmund-Eving, Germany.—1,710,636.

Process of Making Beryllium Oxide. Robert C. Price and Hugh S. Cooper, Cleveland, Ohio, assignors, by mesne assignments, to Baryllium Corporation of America.—1,710,840.

Process of Producing Hydrogen. John S. Beekley, Wilmington, Del., assignor to Lazote, Inc., Wilmington, Del.—1,711,036.

Chemical Engineering Processes and Equipment

Method of and Apparatus for Controlling the Quality or Total Heating Value of a flowing mixture of fluids. Clarence S. Pinkerton, Milwaukee, Wis., assignor to The Cutler-Hammer Mfg. Co., Milwaukee, Wis.—1,704,101.

Water-Softening Apparatus. Edwin A. Robertson, Lake Wawasee, Ind., assignor, by mesne assignments, to The Permutit Company, New York, N. Y.—1,704,925.

Grinding Machinery. George W. Binns, Cincinnati, Ohio, assignor to Cincinnati Grinders Incorporated, Cincinnati, Ohio.—1,705,230.

Gas and Liquid Contact Apparatus. Walter French Slater, Mansfield, England, assignor to Kirkham Hulett & Chandler Limited, London, England.—1,704,518.

Separation and Liquefaction of Gases. William Spencer Bowen, Westfield, N. J.—1,704,649.

Rotary Scrubber and Washer. Tom Jones Noden, London, England.—1,704,663.

Process for Manufacturing Activated Charcoal. Emil Friedrich Scheller, Lorsbach in Taunus, Germany.—1,704,765.

Water-Softening Apparatus. Lynn G. Lindsay, Minneapolis, Minn., assignor to Trupar Manufacturing Company, Dayton, Ohio.—1,704,982.

Clarifier and Thickener. Henry G. Schwarz, Denver, Colo.—1,704,993.

Electrochemical Means for Protecting the Interior of Pipes Against Corrosion. Ronald Van Auken Mills, Sandy Spring, Md., assignor to Peter Q. Nyce, Washington, D. C.—1,705,197.

Filter: Heinrich Notz, Magdeburg-Buckau, Germany, assignor to Maschinenfabrik Buckau R. Wolf Aktiengesellschaft, Magdeburg-Buckau, Germany.—1,705,226.

Tunnel Kiln. William Lee Hanley, Jr., Bradford, Pa.—1,705,475-77.

Process of Softening Water. Stanley A. Sanford, Shaker Heights, Ohio.—1,705,589.

Cement Kiln and Feeder Control. Robert W. Ryder, San Francisco, Calif., assignor to Santa Cruz Portland Cement Company, San Francisco, Calif.—1,706,592.

Filter-Cell-Washing Machine. James Jarvis Preble, Newton, Mass.; Livingston Stebbins, administrator of said James J. Preble, deceased, assignor to Spraco, Inc., Somerville, Mass.—1,705,680.

Means for Conserving Centrifuged Liquids. Hans Olof Lindgren, Stockholm, Sweden, assignor to The De Laval Separator Company, New York, N. Y.—1,705,934.

Manufacture of Cement by the Wet Method in Rotary Kilns. Thomas Rigby, London, England.—1,706,748-50.

Production of Titanium Tetrachloride. Chales de Rohden, Baltimore, Md., assignor to Commercial Pigments Corporation, New York, N. Y.—1,707,257.

Regeneration of Kieselguhr. Alphonse M. Duperu, Crockett, Calif.—1,708,362.

Production of Sodium Starnate. Horace Russell McIlhenney, Rahway, N. J., assignor to Vulcan Detinning Company, Sewaren, N. J.—1,708,392.

Fluid Separator. Grant D. Bradshaw, Pittsburgh, Pa., assignor to Blaw-Knox Company, Blawnox, Pa.—1,708,650-4.

Absorption Apparatus. Guy B. Taylor, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,708,685.

Water-Softening Apparatus. Charles P. Eisenhauer, Dayton, Ohio, assignor to Duro Company, Dayton, Ohio.—1,708,916.

Method for Converting Silicates Containing Lithia with Neutral Alkali Metal Salts. Conway von Girsewald, Frankfort-on-the-Main, Germany.—1,710,556.

NEWS *of the Industry*

Chamber of Commerce Holds Annual Meeting

AN enthusiastic and well attended convention of the Chamber of Commerce of the United States gave its attention to a number of fundamental problems affecting the economic and social welfare of the United States in the seventeenth annual convention, held in Washington April 29 to May 3. The general theme of the meeting, "Growing responsibilities of business," has been favorably commented upon as renewed evidence of the leadership being successfully assumed by the Chamber in the advancement of business ethics in the United States.

"The impact of science on business," as discussed by C. F. Kettering, of the research laboratories of the General Motors Corporation, was a technical highlight of the convention. Tariff principles and the relation of government policies to development of raw materials and water power were subjects of round-table conferences which have some significance for the chemical engineering industries of the country. Because of the far-reaching influence which formal decisions of the Chamber have, special interest always attaches to the subject matter of the resolutions adopted at these annual gatherings. This year's resolutions discussed and made constructive recommendations regarding reduction of armaments, credit situation, agriculture, railroad rate making, merchant marine, federal courts, federal, state, and local taxation, Tariff Commission, import and export prohibitions, mineral industries (favoring greater support for the Bureau of Mines and U. S. Geological Survey), forest resources, and numerous other general subjects of large industrial significance.

AT the round-table conference the subject of government ownership and operation of water power was discussed by M. O. Leighton, consulting hydraulic engineer of Washington. He cited the generous supply of power for American industry as probably the basic reason for the outstanding advance of the United States in economic welfare.

Discussing the problem of Muscle Shoals he pointed out that this question had been settled by obsolescence. He stated categorically that water power in the United States is already obsolescent. He stated definitely that he did not mean that it was obsolete, nor that it would no longer be developed in certain areas, nor that it would no longer be used at any point where developed. He pointed out, however, that the advance of coal utilization for power production has been so great during the last eight years that from now on only those rarely favorable water-power sites can longer be developed.

Charles J. Brand, executive secretary of the National Fertilizer Association, spoke against subsidy which might, through government aid, provide unfair competition with private enterprise. He advocated the thesis that government should not in any way "lend the public credit, public appropriations or public property to any private enterprise that would thus be singled out for preferential treatment under conditions creating unfair and uneconomic competition, constituting in effect government operation by subsidy or subterfuge, such as is contemplated by legislation pending in Congress for the disposal of Muscle Shoals."

Rubber Chemists Discuss Use of Stearic Acid

THE Rubber Division, New York Section of the American Chemical Society, held its first meeting of the current season at Town Hall Club, New York City, March 20.

After dinner many well known experts discussed the manufacture, properties and proper use of stearic acid in the various divisions of the industry. Papers were presented by J. T. Blake on some theoretical aspects of the wetting action of stearic acid; D. F. Cranor on the nature, manufacture and general uses of stearic acid; R. P. Dinsmore on the effect of stearic acid on organic accelerators; E. W. Fuller on the effect of stearic acid on various crude rubbers; C. O. North on the effect of progressive additions of stearic acid on the abrasive index; W. F. Russell on the early experiment with stearic acid; H. A. Winkelman on the use of stearic acid in the reclaimed-rubber industry and J. R. Sheppard on stearic acid in litharge compound.

Chairman W. B. Wiegand and his officers have changed the policy for the current year, making an effort to increase sociability among the members by having the group activities committee act as a welcoming committee, by having the meetings interspersed with song and music by the New York Club Quartette and by furnishing members with badges on which their names and business connections could be written.

Industry Hazards Studied by Chemical Section, N.S.C.

HEALTH and industrial hazards in a wide variety of chemical industries were enthusiastically discussed by 200 safety engineers and production men who attended the mid-year meeting of the Chemical Section of the National Safety Council held in Rochester, N. Y., April 17 and 18. In addition to arranging the program, A. L. Armstrong, safety engineer of the Eastman Kodak Company, provided for plant visits to Kodak Park and the works of six other large Rochester industries.

A feature of the convention was a round-table discussion of safety in chemical industry which was led by Harold L. Miner, manager of the safety and fire protection division of the du Pont Company. There were approximately 40 representatives of the various plants of this company in attendance, and most of them contributed something to the discussion. Other papers included a review of the health hazards in rayon manufacturing by George E. Minshull, of the Du Pont Rayon Company; "Safety in the Laboratory," by Dr. H. LeB. Gray, head of the organic chemical laboratory of the Eastman Company. His associate, Dr. Ben J. Slater, discussed "Health Supervision in the Chemical Industry," particularly the rôle of the industrial physician. A paper on the "Control of Lead Poisoning in Industry," prepared by Dr. J. C. McDonald, of the U. S. L. Battery Corporation, was read and discussed by Dr. A. E. Russell, of the U. S. Public Health Service. Dr. G. H. Gehrmann, of E. I. du Pont de Nemours & Company, told of the control of poisoning in the chemical industry.

A running account of this meeting has been prepared as a news-letter for the members of the Chemical Section and mimeographed copies are available to plants in the chemical industry through the editorial offices of *Chem. & Met.*

Merger in Alcohol Trade

Early in May, announcement was made of the formation of the General Industrial Alcohol Corporation of Delaware. The new corporation will acquire the business and assets of the General Industrial Alcohol Company, Inc., at Marrero, La., and the National Industrial Alcohol Company, Inc., at New Orleans.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

WHILE MORE changes than had been anticipated were made by the Ways and Means Committee in the chemical schedule of the new tariff bill, the measure, so far as that schedule is concerned, is regarded as simply a readjustment and is far from being a real revision. The bill as reported by the committee takes care of most of the weak spots in the present law as it applies to competitive developments. The presidential proclamations with regard to changes in the chemical schedule were perpetuated. American valuation on dyes was retained. The committee was not impressed by the big push made on behalf of domestic oils and fats. Blackstrap molasses was made dutiable at 2.19c. per gal. and tapioca was kept on the free list.

The soap industry is particularly pleased with the outcome. The textile industry was treated with a considerable degree of liberality, but the farm organizations are greatly disappointed in the treatment accorded the agricultural schedule. In the opinion of Chester Gray, of the Farm Bureau Federation, the farmers were given 50 per cent of the absolute minimum of any reasonable interpretation of their requirements.

The bill is being stoutly defended by the Republican leaders in the House as full compliance with the promise to adjust the tariff to the changes incident to the competitive situation and to make special provision for agricultural and the textile industry. Activities such as watchmaking, which have been depressed by importations, have been singled out for special attention.

Expressions from Democratic leaders indicate that the new tariff policy of the party announced during the campaign is to be effective on the agricultural schedule only. There will be some co-operation with the Republicans on the agricultural schedule, but most of the other changes proposed seem to be meeting with opposition of the partisan type. The Democrats, however, are facing numerous serious internal differences over the rates applying to a long list of individual commodities.

THE fertilizer industry failed in its effort to secure protection on compounds or mixtures of two or more plant foods. On the other hand, urea, which had been dutiable as a chemical at 35 per cent ad valorem, was transferred to the free list. Sulphate of ammonia remains dutiable in the new bill. To justify the continuation of this duty, the committee devotes a paragraph of its report to fixed nitrogen. It reads as follows: "One of the outstanding accomplishments of the period covered by the present tariff act is the rapid development in this country during the last two or three years of the fixation of atmospheric nitrogen in the form of synthetic ammonia. Plants for the production of nitric acid by the oxidation of anhydrous ammonia are displacing the old process of manufacture from Chile saltpeter. The ultimate capacity of the plants now in operation and under construction will render the United States entirely independent of foreign raw material—that is Chile saltpeter—for the manufacture of nitric acid. In addition, one large plant is producing synthetic nitrate of soda for fertilizer purposes. The availability of cheap nitric acid is of far-reaching significance to industry, agriculture, and national defense, for agriculture in the form of cheaper fertilizers, cheaper explosives for roads, and cheaper articles of innumerable kinds which the farmer uses; for military defense, independence of foreign raw materials for the manufacture of munitions."

While the rate accorded blackstrap molasses falls far short of the eight cents asked by the farm organizations, the proposed tariff is certain to come in for sharp attack with indications pointing to some reduction in the Senate. The assessment is on total sugars to avoid the reductions incident to the dilution of imported blackstrap.

FOR chemical purposes, the oils and fats situation is almost unchanged under the new tariff bill. With the Timberlake resolution discarded by the committee, the bill cannot seek to levy duties on the large coconut oil and copra imports from the Philippines which are most important in the vegetable oil problem. In the edible field, lard is the dominant factor and, being a large export item, lard can receive no tariff benefit. Following is the explanation given in the Ways and Means Committee report: "Vegetable oils constituted one of the controversial subjects in the chemical schedule. On the one hand, the farm group requested a flat 45 per cent ad valorem rate, or the equivalent specific rates on animal and vegetable fats and oils of all kinds, whether produced in the United States or not, and with the declared purpose of raising the price level of domestic fats and oils. On the other hand, the soap manufacturers, the power laundry interests, and others, either consumers of fats and oils for the manufacture of soap, or of soap itself, protested such increases mainly because they claimed this would increase the cost of soap by about 50 per cent.

"The committee has made an exhaustive study of the numerous phases of the oils and fats situation. Coconut oil, which is predominantly the most important of the imported vegetable oils, enters duty free almost entirely from the Philippines and is, therefore, the most important factor in considering the vegetable oil problem. About 60 per cent of the consumption of coconut oil is in soap, and about 33 per cent is in edible products. Without placing a duty on imports from the Philippines, increased duties on other oils and fats would be meaningless. Furthermore, lard which is the dominating factor influencing the price of edible fats and oils, is exported to the extent of about 800,000,000 pounds annually. On the other hand, about 700,000,000 pounds of inedible fats and oils are imported to supply the deficiency of soap fats and oils. For these reasons the committee has made but few changes in the oils and fats paragraph of either the chemical schedule or the free list.

"THE duty on linseed oil has been increased to include the compensatory from 56c. per bushel, the new rate on flaxseed. The duty on soy-bean oil has been doubled, in order further to encourage the domestic production of soy beans and of soy-bean oil. Sesame oil, which is used chiefly as a salad oil and olive oil adulterant, competes directly with cottonseed, corn, and peanut oils produced in the United States. The committee transferred it from the free list to the dutiable list. Palm-kernel oil, although used almost entirely in the manufacture of soap is suitable for the manufacture of margarines. The committee transferred this oil from the free list to the dutiable list, but in the provision permitting free entry of olive oil when denatured so as to be unfit for edible purposes, also included palm-kernel oil when similarly denatured. Thus, the soap maker is not penalized for his requirements of palm-kernel oil and the edible oil price level can not be affected by duty-free entry of edible palm-kernel oil."

No change was made in the basic rate of 45 per cent ad valorem on dyestuffs. The Ways and Means Committee points out that the coal-tar products have made a very creditable showing under the present tariff. Therefore it is deemed unnecessary to go back to the 60 per cent rate temporarily applied for development purposes and once more urged by the industry. Intermediates likewise remain untouched at the present rate of 40 per cent.

American selling prices of like or similar commodities were retained as the basis of dyestuffs valuation. The clause prohibiting any rate increases in paragraphs 27 and 28 is stricken out so that dyes and intermediates may now benefit by Tariff Commission procedure under the flexible provision.

By similar reasoning, the chemical basket clause, Paragraph 5, which applies to all chemicals not otherwise specially provided for, remains un-

changed at 25 per cent ad valorem. Numerous items now under the basket clause, however, are given places in other paragraphs with some duty changes.

BY reason of developments in the rayon industry, the committee lists cellulose compounds in considerable detail and fixes new duties. Additions to paragraph 31 are, briefly, as follows:

a. Cellulose acetate, its compounds and mixtures—

1. In blocks, sheets, etc., and cellulose acetate rayon wastes not made into finished or partly finished articles, 50c. per lb.
2. Made into finished or partly finished articles, 80 per cent ad valorem.

b. All compounds of cellulose except cellulose acetate but including pyroxylin and other cellulose esters and ethers.

1. Blocks, sheets, etc., not made into finished goods, 40c. per lb. except transparent sheets more than 0.003 in. thick and not more than 0.032 in. thick, 45c. per lb.
2. Made into finished articles, 60 per cent ad valorem.
3. Transparent sheets of cellulose not over 0.003 in. thick, chiefly used in wrapping, 45 per cent ad valorem.

The principal cellulose compounds used in the rayon industry were formerly assessed at 40c. per lb. on raw products and 60 per cent ad valorem on finished or partly finished articles.

Rayon has been recognized by name as a distinct fiber and has been given a separate classification, Schedule 13, in the tariff bill. The former listing was under "artificial silk" paragraphs in the silk schedule. Rate increases on rayon are relatively small.

CENTRALIZATION of tariff power in the president is in effect proposed through the administrative paragraphs of the new tariff bill. The Chief Executive is given unrestricted authority to choose his own Tariff Commission. He retains the right under the flexible provision to raise or lower the rate on any dutiable item by fifty per cent and can apply American selling cost valuation where other methods fail. His Secretary of Treasury has the final say on appraisals which eliminates legalistic quibbling through the Customs Court and Customs Court of Appeals. In short, the entire mechanism is speeded up with one controlling hand to make or brake the nation's foreign trade policies.

These recommendations parallel and in most cases meet the requests of manufacturing groups throughout the country wishing quick tariff action to keep pace with changing industrial conditions. The further intent is to lessen the need for general revisions which are a long time in coming to the aid of a needy industry and create periods of business uncertainty and readjustment when they finally do materialize. Business on the whole will be pleased with the committee's action but whether Congress will see fit to delegate so much power is yet an open question.

Among the proposed changes, the Tariff Commission is increased from six to seven members and the salary raised from $10,000 to $12,000 per year.

TARIFF changes of interest to the chemical indstry are here tabulated. Plain figures in the rate colums indicate specific duties in cents per pound unless some other quantity unit is given. Rate figures in percentages are ad valorem duties. The abbreviation "n.s.p.f." means "not specially provided for." Where the existing rate is left blank, in most cases the item concerned has been dutiable heretofore at 25 per cent ad valorem under the chemical basket clause. Items are listed according to paragraph numbers in the new tariff bill.

The following items were transferred to the free list (figures in parentheses are the former duties): Argols, tartar, and wine lees less than 90 per cent in potassium bitartrate content (5 per cent); calcium arsenate; eulachon oil; copper iodide; Paris green (15 per cent), santonin and salts thereof (75c. lb.); urea (35 per cent).

Transfers from the free list to the dutiable list follow (figures in parentheses are the proposed duties): Chromic acid (25 per cent); nitric acid (½c. lb.); lemon, lime, and sour-orange juice unfit for beverage purposes (5c. lb.); kieserite (¼c. lb.); spermaceti wax (6c. lb.); palm kernel oil (1c. lb.); sesame oil (3c. lb.); crude feldspar ($1.50 ton).

Other items are strengthened in the chemical schedule by providing that mixtures containing such an item as the component of chief value shall pay the full duty laid on the item itself. Numerous new chemicals are specifically mentioned by name in their appropriate paragraphs, particularly in the acetaldehyde, coal tar, and cellulose groups. Under the mineral schedule, several alloy metals and compounds are recommended for changes and increases, notably tungsten.

Chemical and other scientific glass utensils receive a duty increase from 65 per cent to 85 per cent ad valorem. Utensils of fused quartz or fused silica are levied at 50 per cent.

Paragraph	Item	Rates	
		Existing	Proposed
1	Acids: Citric	17	18
	Formic	.....	4
	Tannic: Extracts less than 50 per cent	4	6
	Extracts over 50 per cent, not medicinal	10	12
	Extracts medicinal	20	22
	Tartaric	6	8
	Gallic	8	10
	Oxalic	4	6
	Phosphoric less than 80 per cent	.....	2
	over 80 per cent	.....	3½
	Pyrogallic	12	15
4	Methanol	12	18
7	Ammonium carbonate	1½	2
11	Synthetic gums and resins n.s.p.f.	.....	4 plus 30 per cent
12	Barium: Carbonate, precipitated	1½	2
	Dioxide	4	6
	Oxide	.....	2½
69	Precipitated sulphite or blanc fixe	1	1½
16	Calcium oxalate	.....	4
17	Calomel, corrosive sublimate, and other mercurial preparations	45 per cent	22 plus 25 per cent
20	Chalk, whiting or Paris white: Dry, ground, or bolted	25 per cent	½
26	Diethylbarbituric acid, salts, and compounds	.....	250
33	Galalith or other casein products made into wholly or partly finished articles	40 plus 25 per cent	40 plus 50 per cent
42	Edible gelatin in value less than 40c. lb.	20 per cent plus 3½	20 per cent plus 5
	Gelatin, glue size, and fish glue n.s.p.f. in value less than 40c. lb.	20 per cent plus 1½	25 per cent plus 2
	Over 40c. lb.	20 per cent plus 7	25 per cent plus 8
50	Magnesium: Sulphate or epsom salts	¼	1
	Oxide or calcined magnesia	3½	7
53	Sperm oil, refined or processed	.....	14c. gal.
	Wool grease over 2 per cent free fatty acids	1	1
	2 per cent or less, not medicinal	1	2
	2 per cent or less, medicinal	1	3
54	Linseed oil	3. 30c.	4. 16c.
55	Soya bean oil	2½	5
67	Paint sets, kits, or color outfits		
	In tubes or jars	.....	2c. ea. plus 40 per cent
	In cakes, pans, or other forms	.....	1½c. ea. plus 40 per cent
71	Decolorizing, deodorizing, or gas-absorbing chars and carbons whether or not activated	20 per cent	45 per cent
78	Vermillion reds	28	22 plus 20 per cent
	Cuprous oxide	.....	35 per cent
80	Potassium: citrate	.....	18
	chlorate and perchlorate	1½	2½
	nitrate, refined	¼	5½
	permanganate	4	6
81	Sodium and potassium	.....	25 per cent
83	Sodium: formate	2	2½
	nitrate	3	4½
	oxalate	.....	3½
	phosphate, except pyro-phosphate less than 45 per cent water by weight	.....	1
	n.s.p.f.	.....	2
	sulphate, anhydrous	$2	$4
85	Potato starch	1½	2½
86	Dextrine made from potato starch or potato flour	2½	3
	Dextrine n.s.p.f. and soluble or chemically treated starch	1½	2
88	Strychnine and salts thereof	15c. oz.	20c. oz.
92	Vanadic acid, salts, compounds, and mixtures	.....	40 per cent
94	Zinc sulphide	1½	3
95	Collodion emulsion	.....	25 per cent
Schedule 2—Earths, earthenware, and glassware			
204	Caustic calcined magnesite	½c.	15/16c.
213	Graphite, crystalline: lump, or dust	20 per cent	25 per cent
	flake	1½	1½

British Chemical Company Will Increase Nitrogen Output

Imperial Chemical Industries Will Expand Billingham Plant

From Our London Correspondent

THE DISSOLUTION of Parliament and the throes of a general election are close at hand and their influence upon trade and industry, although definitely apparent, has not been as serious as might have been anticipated. One direct consequence has been a slowing down and now practically a cessation of the newer and more speculative issues of capital, sometimes relating to sound enterprises, but more often resting upon the slender foundation of unproved or highly speculative technical and mechanical processes.

Those competent to judge of the situation are definitely optimistic in regard to the future outlook of industry as a whole and the British chemical industry in particular. The position as regards the latter can perhaps be summed up by paraphrasing a recent utterance of the British Prime Minister and saying that "We want neither slumps nor booms in prices, and we want neither stunts nor stagnation in research." The budget has given no material stimulus, but there is the encouragement of the probable continuation of stable government and the further and reasonable application of the "safeguarding of industry" import duties. The latter may ultimately extend to the iron and steel industry for the rationalization of which the first move has just been made. Instead of reconstruction, an offer has been made for the whole of the shares in the United Steel Companies, Ltd., and the United Strip & Bar Mills, Ltd., and by thus achieving the same object in a rational manner, the foundation has perhaps been laid for the building up of a more extended organization.

THERE will be repercussions in the coal and chemical industries, of course, and as regards the various contemplated centralizations and extensions of coke-oven plants the report of the Area Gas Committee will be awaited with great interest later on this year. Some of the members have been investigating the possibilities of gas supply and distribution in Germany and elsewhere, and the possibilities of nitrogen fertilizers as a subsidiary and profitable manufacture are not likely to be overlooked. In this connection, the decision to review and examine favorably increased allowances for obsolescence of machinery and plant should be of particular advantage to the chemical industry, in which it is by no means impossible for a plant to be out of date by the time it is built.

In one very favored European country, the government in its wisdom allows as much as 30 per cent of the value of a chemical plant to be written off, provided this is done in the first year of its operation. Something similar is too much to hope for, but the present scale allowed for obsolescence in this country before income tax becomes chargeable is more applicable to mediæval times than to a chemical age.

The report of Imperial Chemical Industries and the annual meeting, at which an increase of capital of $100,000,000 was approved, are naturally events of outstanding importance. Although this additional capital is not immediately required, it is common knowledge that a large proportion of it will be devoted toward the extension of the Billingham nitrogen factory, which by the beginning of 1930 will be producing at the rate of 150,000 tons of nitrogen per annum. Unfortunately, it cannot be said that the Billingham plants have been economically or cheaply built, in fact their capital cost probably has been two or three times that of equivalent Continental factories, largely due to the lengthy and laborious process of research and development which was found necessary. Future extensions are likely to be more economical and it speaks volumes for the optimism and confidence placed in the future of the nitrogen and fertilizer industry that the present earnings justify the extension planned.

NATURALLY Billingham is not solely concerned with synthetic ammonia, and it is now common knowledge that an acetic acid factory and a methanol plant are in operation. The heavy cost of building Imperial Chemical House has been financed by means of a long-term loan from a leading insurance company and the capital involved therefore does not have to earn dividends at the same rate as the productive side of this budding chemical colossus. The company's reserves now total some $55,000,000, but the greater part of this has been obtained from share premiums and as the result of the liquidation of Nobel Industries, Ltd. The general view is that I.C.I. may pass through some difficult times during the next year or so, but that thereafter they will pass from strength to strength.

Chemical & Wood Industries, Ltd., has just been formed with a share capital of some $5,000,000, in order to exploit timber and wood distillation plants in Jugo-Slavia and incidentally to take over the well-known Suida patents for the manufacture and concentration of acetic acid. The Suida patent has already been licensed in a number of countries and to leading concerns therein, such as the German I.G., and the issue is of particular interest because Lord Melchett's son is a director of the issuing house concerned and there are other signs that indirectly Imperial Chemical Industries may be able to use this concern as a jumping-off ground for industrial expansion in the near East.

From the technical standpoint there is much more of interest in the recently issued prospectus of the Zinc Manufacturing Company, Ltd., having the same amount of nominal capital. This is a subsidiary company formed to manufacture zinc by the Coley process, which already has a successful record and in connection with which the N. C. Metal Company and the N. C. Zinc Oxide Company have been outstanding successes on the British share market. Mr. Coley will be familiar to readers as the first honorary secretary of the Chemical Industry Club, and although not a chemist has succeeded in blazing unknown trails and satisfying those who originally scoffed at the belief that it is possible to substantiate new theories which can have no reasonable foundation in text books and fundamental science.

Turning now to the activities of societies and institutions, the nomination of Dr. Herbert Levinstein as president of the Society of Chemical Industry next year has been extremely popular; his name is well known in America for his work on mustard gas, dyestuffs and more recently acetate rayon. The annual meeting at Manchester includes a garden party at Dr. Levinstein's house, at which it is hoped that a large contingent of visitors from America will be present.

Sir Alexander Gibb's second year of office has just ended on a note of personal triumph and substantial achievement in the interests of the Institution of Chemical Engineers. Sir Alexander's personality and lovable character have made if possible a stronger appeal to his colleagues here than even to his friends in America.

Arthur D. Little Describes Process Development

AT A joint meeting of the Society of Chemical Industry and the New York section of the American Chemical Society in New York on May 3, Dr. Arthur D. Little, American president of the former organization, spoke to a capacity audience on the subject of "Process Development." Its present status, he declared, is the outcome of a change in view from the older "process entity" idea to that of a "co-ordinated series of unit processes," the article of faith of chemical engineering. Remarking further that most major processes have at one time been on the verge of failure, Dr. Little proceeded to outline the logical steps and cautions necessary in the rearing of a fledgling process. By way of summary he concluded with an illustrated description of the steps in the career of an actual vapor-phase cracking process undertaken several years ago.

Synthetic Perfume Industry Develops in France

Remarkable Growth Reported in Comparison With Pre-War Standards

From our Paris Correspondent

THE PERFUME industry is of great importance in France, not only the natural perfumes coming from the Southern provinces — Grasse, Cannes, Nice, etc.—but synthetic perfumes used in the manufacture of lotions distributed throughout the world.

Before the war the Parisian perfume industry did about 100 million gold francs worth (500 million present day Fr. francs) of business yearly. Since the war the sales of perfumes and beauty products has increased materially.

New synthetic products have been developed recently, among them synthetic musk manufactured by the firm of Naef & Co. of Geneva. This synthetic musk has exactly the same odor as that of ibex musk.

According to the Swiss firm of Naef & Co. the annual consumption of natural musk is about 2,400 kil., worth 10 million gold francs (50 million present day paper francs). Artificial musk synthetically obtained is at present too expensive to produce, especially as artificial musks made out of nitrate—xylene musk and ambrett musk—are manufactured at such a low price. These artificial musks have not, like synthetic musk, a delicate scent but in spite of this inferiority their cheapness insures them a large and profitable sale, and they are not likely to be replaced for some time by synthetic musk.

Hydroxycitronellal obtained by hydration of citronellal finds many uses as a perfume composite, either for replacing or in imitation of the lily of the valley's fragrance.

A most interesting and accurate study of this product has been made by Mr. Sornet, a young chemical engineer, who has developed a new perfume hydroxycitronellal. Thanks to Mr. Sornet's researches this product may now be obtained as a fragrant product, while up to now, owing to its several isomeric forms, it was only known as an inodorous product.

Statistics recently published show the growing importance of the ore output, and its growing imports and exports in France.

France, the second iron ore producer in the world, produces about 40 million tons of iron ore yearly. On the other hand France has to import yearly, growing quantities of pyrites for the manufacturing of sulphuric acid, the total output of the only French pyrite mine, at St. Bel, being 200,000 tons per year only,. whereas the home needs are 750,000 tons yearly. Thus imports reached a value of 115 million Fr. francs in 1928. On the other hand France exports bauxite. In 1928, on a total yearly output of 400,000 tons coming from the Var, Hérault, and Bouches-du-Rhêne districts, 250,000 tons were exported to Germany, Great Britain and the United Statts.

France has a large consumption for manganese ore and depends entirely on foreign ores for her home needs.

WE have mentioned in a previous letter the formation of a new company by the following firms: Rhodiaseta, Textiles Chimiques Du Nord & De L'Est, Cie. de Saint Gobain for the manufacture of acetate rayon by the Rhodiaseta process, a well known and well tried process. The working capital of this new company is 60 million francs and not 6 million as a slip of the pen made us write.

In order to commemorate the name of the late Count Chardonnet the inventor of rayon, Lyonnese silk producers and silk merchants will henceforth call artificial silk "Chardonnet" silk, a tardy but well deserved recognition of the important discovery made by that most disinterested scholar.

There are, at present, three kinds of Chardonnet silks manufactured in France: Viscose Chardonnet, acetate chardonnet and copper chardonnet. Nitrate chardonnet which Chardonnet had developed is no longer manufactured except in an Amiens factory which uses the Delpech process. Experience will show whether this process is a good one.

No accurate information can be obtained on alcoylated silks which are not yet obtainable. As the rights of ownership of the patent processes used are not clearly defined, there are difficulties involving attempts to manufacture.

The I. G. Farbenindustrie A.G., however, is offering in France a chemical product called Colloresine D, obviously nethylic cellulose, which is used as "thickening" for the printing of vat colors, by hand, by aerograph and by heliegraph.

The benzylcellulose made by the same firm is also widely known, notably for the cellulosic varnish; this product is not easily obtainable yet, and is too expensive to be industrially used.

T.A.P.P.I. Will Hold Fall Meeting at Richmond

IN conjunction with the Exposition of Chemical Industries, a meeting of the Technical Association of Pulp and Paper Industry was held May 8, at Grand Central Palace, New York City. Unusual interest was manifest in the papers on Welded Pressure Digesters, by J. McLean Jasper, of the A. O. Smith Corp., and High Chrome—High Nickel Stainless Alloys in the Sulphite Process, by Lee Wallis Gibbons. Other interesting papers presented were on An Improved Paper Mill Concrete Floor, by M. W. Meyer, Anti-Hydro Waterproofing Co.; on Continuous Stokers Featuring Insulating Board Machines, by Charles Fuhrmeister, Jr., Oliver United Stokers; and on Shipping on Skid Platforms, by E. S. Powers, of Lewis-Shepard Company.

The executive committee decided to hold the fall meeting at Richmond, Va., on September 24, 25, and 26, and in Washington, D. C., on September 27.

To Confer on Education in Chemical Engineering

THE third conference on chemical engineering education under the auspices of the committee of the American Institute of Chemical Engineers will be held at the Bellevue-Stratford Hotel, Philadelphia, at 10 a.m. on Saturday, June 22. It is expected that it will be largely attended by representatives from the industries as well as from the schools and colleges in which chemical engineering is taught.

H. C. Parmelee, chairman of the Institute's committee, will preside and papers will be presented by Prof. Harry McCormack of Armour Institute, Prof. W. K. Lewis of Massachusetts Institute of Technology, Prof. Harry A. Curtis of Yale University, Prof. T. R. Running of the University of Michigan, and Prof. Arthur W. Hixson of Columbia University. Webster N. Jones, general superintendent of the processing division of the B. F. Goodrich Co., will open the discussion of "Industry's Appraisal of the Chemical Engineering Graduate."

Chemical Engineers to Meet in Philadelphia

DISTILLATION is to be featured in a comprehensive symposium conducted by the American Institute of Chemical Engineers at its semi-annual meeting in Philadelphia, June 19, 20 and 21. A. G. Peterkin, Jr., of the Atlantic Refining Company, has arranged for a group of papers discussing chemical engineering problems in the petroleum, lacquer, and solvents industries. Speakers will include R. S. Piroomov and N. E. Loomis of the Standard Oil Co. of New Jersey, W. J. Murray and E. P. Stevenson of Arthur D. Little, Inc., M. C. Rogers and G. G. Brown of the University of Michigan, A. M. McAfee of the Gulf Refining Company, A. A. Backhaus of the U. S. Industrial Alcohol Company, Eugene Ayres of Sharples Solvents Corporation, Charles L. Gabriel of Commercial Solvents Corportion, J. H. Monaweck and E. M. Baker of the University of Michigan, and R. B. Chillas and H. M. Weir of the Atlantic Refining Company.

Charles W. Cuno of St. Louis is to discuss the "Migration of Industry" and there also will be a paper by D. S. Chamberlain and Arthur Rose of Lehigh University on carbon black formation. Headquarters of the convention will be at the Bellevue-Stratford Hotel.

Germany Progresses in Utilization of Coke Oven Gases

Important Developments Forecast for Conversion of Methane by Electric Discharges

From our Berlin correspondent

IN 1928 Germany consumed 157,400,000 tons of coal, compared with 153,700,000 in 1927 and 133,200,000 in 1926. The automotive field during 1928 used 1,272,000 tons of liquid fuels; but whereas the number of vehicles rose by 29 per cent, the consumption of fuels increased (from 900,000 tons in 1927) by 41 per cent, reflecting a greatly increased individual mileage for vehicles. Half a million tons of the demand was met by domestic production (benzol, synthetic benzine, lignite benzine, alcohols) and the remainder, about 772,000 tons, had to be covered by imports.

The production of synthetic gasoline at the Leunawerke of the I. G. totalled during 1928 not, as sometimes reported, 70,000 tons, but about 30,000 tons, although the daily production at the end of the year corresponded to the former figure. The anticipated total for 1929 is at least 100,000 tons. Incidentally, at Leuna the processing of heavy oils and tars is said to be an important contributing source beside the liquefaction of coal.

The director of the Institut für Kohlenforschung at Mülheim, Franz Fischer, has just announced some results obtained with K. Peters which promise important future developments. The work involves conversion of methane, or coke oven gas, by means of electric discharges at reduced pressure, to the reactive radicals CH_2, CH_3 and CH, rather than just carbon and hydrogen. The synthesis of ring compounds from methane at ordinary pressure had already been accomplished by Fischer a half year ago.

HIS present work is a significant step in the utilization of coke oven gases. In making acetylene from them, Fischer uses the following procedure: The gas is sent at a pressure of 15 mm. Hg. through a porcelain tube at the ends of which are two electrodes of Krupp V2A steel, about 40-60 cm. apart. The current passing through is 50-cycle a.c. at 7,000 volts and 100 milliamperes. A typical result was the conversion of 1,000 lit. of coke oven gas (523 lit. H_2 and 234 lit. CH_4) to 1,230 lit. of gas containing 860 lit. H_2 and 190 lit. C_2H_2, with an additional 4 lit. of HCN gas as byproduct. The applications of such a gas are numerous; it may be profitably converted to volatile paraffine hydrocarbons as well as to benzene compounds and it may be directly catalyzed to acetaldehyde and alcohol under conditions that are known.

At the recent Paint Symposium the problem of greatest interest to engineers was the combating of corrosion, a cause to which the National Railway contributes 48,000,000 M. annually. Protection by paint is now featured by quick-drying lacquers and spray application. Taking up the subject of lithopone, Professor Maass reported that its resistance to expansion could be increased by changing its manufacture so as to give a final alkaline reaction, which would saponify the vehicle.

The German potash industry achieved very favorable results in 1928. The total production value reached the record mark of 260,000,000 M., whereas the highest figure before the War, including the Alsatian properties, was 200,000,000 in 1914. This increase is due primarily to the manufacture of nitrogenous mixed fertilizers, also to improved production methods. The outlook for the future seems favorable in view of the latest steps in heavy chemicals technology.

The Ring G.m.b. H. (Chemische Fabrik Riedel) is part owner of new patents for the manufacture of caustic. Briefly, the process involves the production of caustic soda from salt and calcium carbonate by the use of fluorine compounds, which are constantly regenerated. The steps are: (1) To an acid solution of sodium chloride, containing precipitated CaF_2 from a third manufacturing step, is added gaseous SiF_4 from the second step. The product is a firm sodium fluosilicate which is filtered out of the CaH_2 solution. (2) The fluosilicate is broken down at 700 deg. C. to NaF and SiF_4, which is utilized in step one. (3) NaF is converted to caustic soda by addition of milk of lime, a further product being the CaF_2 used in step one. The basic idea of the process dates to 1858, but with its numerous present improvements the only problem that remains now is that of efficient equipment.

A RAPID action valve embodying new principles has been designed by Dr. Karnath, which should have some significance for the valve-ridden oil industry. It contains a thin sheet varying in flexibility with the pressure, and at its critical portions is made of chrome-nickel steel and nickel alloys of great hardness and heat resistance. It is especially valuable for steam systems exposed to high pressure and super-heat. It is now manufactured by the Dinglerschen Maschinenfabrik A. G., Zweibrücken.

A new water-purification method has been instituted by Dr. G. A. Krause of Munich, who utilizes silver for the destruction of pathogenic organisms. It is blown on Raschig rings or any large-surfaced bodies, and water treated with it is afterward found to contain .0015 mg. of the metal as a minimum. In large tests treating 50,000—60,000 lit. per day it was further found that the water, after passage, remains sterile for long periods. A remarkable performance recorded is the destruction of 21 million organisms per c.c. in 48 hours. The process seems feasible for a variety of applications such as the cleaning of containers, glass and in waterworks.

German I. G. Forms American Corporation

ON April 26 it was announced that a new company, to be called the American I. G. Chemical Corporation, would be formed. Formation of the corporation was accomplished under the banking auspices of the National City Company. All of the common stock of the corporation will be issued against cash or for the acquisition of stocks of certain American chemical companies, including a substantial interest in the Agfa-Ansco Corporation, the second largest company in this country engaged in the manufacture and sale of films and photographic materials, and the General Aniline Works, Inc., formerly the Grasselli Dyestuffs Corporation, manufacturers of synthetic organic chemicals and dyestuffs. All these plants are to be made available to the new corporation for the further development of its wide range of products.

The board of directors of American I. G. Chemical Corporation will include, among others:

Prof. Dr. Carl Bosch, chairman of the executive committee, I. G. Farbenindustrie; Walter Teagle, president, Standard Oil Company of New Jersey; Charles E. Mitchell, chairman, the National City Bank of New York; Edsel B. Ford, president, Ford Motor Company; Paul M. Warburg, chairman, International Acceptance Bank, Inc.; Adolf Kuttroff; H. A. Metz, president, General Aniline Works, Inc.; W. E. Weiss, vice-president, Drug, Inc.; Dr. Hermann Schmitz, member, executive committee, I. G. Farbenindustrie; Dr. Wilfrid Greif, member, executive committee, I. G. Farbenindustrie.

An issuance of $30,000,000 in convertible debentures was oversubscribed.

Priestley Medal Awarded To Garvan

THE Priestley medal has been awarded to Francis P. Garvan according to an announcement made by the American Chemical Society. The award is made every three years and in selecting Mr. Garvan, he was referred to as "the greatest lay patron of chemistry in the United States." Mr. Garvan has devoted large sums of money for chemical education, and to research and promotion of the chemical industry. He is president of the Chemical Foundation, Inc.

The Priestley medal was founded in memory of Joseph Priestley, discoverer of oxygen.

MEN *in Chemical Engineering*

GEORGE E. RAMER has been appointed chief engineer of the Hercules Powder Company to fill the post left vacant at the recent death of Robert E. Zink.

RICHARD PENFIELD has joined the American Cyanamid Company's technical staff at the main office in New York. For the past five years Major Penfield has been connected with the Celanse Corporation of America at Cumberland, Md., where he had an active part in the development of the company's new cellulose acetate plant.

WILLIAM R. SEIGLE, formerly vice-president in charge of mines and factories for the Johns-Manville Corporation, has been elected chairman of the board. His career with the firm dates back to 1900, when he joined it soon after graduation from college.

T. O. KOOPMAN has assumed the duties of manager of the National Lead Company's plant at Matawan, N. J. Previously he had been general superintendent.

EMERSON P. POSTE, president of the Engineers Club of Chattanooga, Tenn., has become factory manager of the Chattanooga Stamping & Enameling Company, where he has been chemical engineer since 1925.

H. E. HARING has resigned his position with the Victor Talking Machine Company to engage in electrochemical research at the Bell Telephone Laboratories, New York.

B. SMITH HOPKINS, of the University of Illinois, noted for his discovery of illinium, will be visiting professor at the department of chemistry of Western Reserve University during the coming summer.

ALAN H. HARRIS, JR., for the last nine years coke-oven superintendent for the Bethlehem Steel Company's Lackawanna plant, has resigned to join the sales staff of the Koppers Construction Company, Pittsburgh.

OSWALD SCHREINER, chief of the division of soil fertility at the federal Bureau of Chemistry and Soils, is representing his department as delegate at the Fourth Pacific Science Congress, being held at Java, May 16 to June 4. Dr. Schreiner also will attend the Third Congress of International Sugar Cane Technologists at Sorabaya, June 7 to 21, as delegate of the Department of Agriculture.

BRUCE K. BROWN has accepted a position in the patent department of the Standard Oil Company of Indiana.

SHERRILL B. GREENE has resigned his position as manager of the Baker and Adamson Division of the General Chemical Company. After a vacation lasting several months he will return to New York.

M. L. HARTMANN has resigned as mechanical director of the Celite Company, Lompoc, Calif., in order to devote his time to a consulting practice in Los Angeles.

W. H. WHITCOMB has joined the technical staff of the Henry L. Scott Company, Providence, R. I., after being director for twelve years of the footwear division control laboratory of the United States Rubber Company at New Haven, Conn.

H. W. GILLETT has resigned his position as chief of the division of metallurgy, Bureau of Standards, effective July 1. On that date he will assume active direction of the Battelle Memorial

H. W. GILLETT

Institute, Columbus, Ohio. Plans for the Institute work are already taking form, including arrangements for those fundamental studies in metallurgy, fuel technology, and related fields which are to be covered under the terms of the Battelle will which endowed the Institute.

WILLIAM M. COBLEIGH, head of the department of chemistry and chemical engineering at Montana State College and a member of the staff since 1894, has just been appointed dean of the college of engineering and professor of chemical engineering.

W. J. DENHOLM has been transferred from the Chicago office of the Worthington Pump & Machinery Corporation to the post of assistant to the manager of the Harrison (N. J.) works.

A. R. KEMP, in charge of submarine cable research for the Bell Telephone Laboratories, sailed for Germany on May 8 aboard the *Aquitania* for a stay of six months.

Among the fourteen new members elected to the National Academy of Sciences are ROGER ADAMS, JAMES B. CONANT, and JOEL H. HILDEBRAND, professors of chemistry respectively at the universities of Illinois, Harvard, and California.

JAMES ARTHUR REAVELL, one of the founders of the British Institution of Chemical Engineers, was elected president at its March 20 meeting. Mr. Reavell also is chairman of the British Chemical Plant Manufacturers Association, and has attained prominence during the past twenty years in the manufacture of apparatus for evaporating and drying.

J. C. LINCOLN has been elected chairman of the board of the Lincoln Electric Company, where he is succeeded in the presidency by J. F. Lincoln. The new chairman is prominent for the part he has played as proponent of electric arc welding.

A. J. MARINO, formerly on the engineering staff of the Elkon Works, Inc., Weehawken, N. J., is now with the Gilby Wire Company, Newark, N. J., as engineer.

H. W. BUNKER has been appointed chief engineer for the new plant of the Puget Sound Pulp & Timber Company at Everett, Wash.

C. P. TAYLOR has accepted a new position as chief chemist for the Western Cartridge Company, East Alton, Ill.

EVERETT W. BOUGHTON, recently manager of technical service of the New Jersey Zinc Sales Company, is now in charge of a new sales department for the R. T. Vanderbilt Company, New York, established to serve the paint, varnish and lacquer industries.

C. BANTA, who was chief of research in the chemical department of the Barrett Company, Frankford, Pa., is now head of the department of pure research at the company's laboratories at Edgewater, N. J.

CALENDAR OF FORTHCOMING EVENTS

AMERICAN CHEMICAL SOCIETY, 78th meeting, Minneapolis, Sept. 9-13.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, Toronto, May 27-30, 1929.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, mid-year meeting, Philadelphia, June 19-21; June 22, conference on chemical engineering education.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 24-28.

NATIONAL FERTILIZER ASSOCIATION, meeting, June 10-13, New London, Conn.

NATIONAL METAL CONGRESS, held in conjunction with metal societies, Cleveland, Sept. 9-13.

SEVENTH COLLOID SYMPOSIUM, Baltimore, Md., June 20-22.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Sept. 24-26, Richmond; Sept. 27, Washington, D. C.

C. A. Browne, head of the agricultural chemical work of the Bureau of Chemistry and Soils, is undertaking an extended European trip. Dr. Browne expects to take up numerous official problems and to devote considerable time to a personal vacation while abroad. It is expected that he will be absent from Washington for something over a year.

Edward C. Uhlig was guest of honor at a dinner held on April 3 in recognition of his 25 years' continuous service with the Brooklyn Gas Company, where he is chief chemist. Among the large group present were numerous officials of his own and various other gas companies, as well as representatives from technical organizations and schools.

J. C. Pridmore has resigned from his post as director of the Southern division, soil improvement committee of the National Fertilizer Association, after thirteen years of service. He leaves to join the American Potash & Chemical Corporation and will have his headquarters in New York beginning July 1.

J. S. Coye, formerly with the General Chemical Company, has been appointed director of research and development at the plant of the American Potash & Chemical Corporation, Trona, Calif. Mr. Coye has already assumed the duties of this position which was in charge of Francis MacDonald until his recent resignation.

W. C. Anderson has been transferred to the special products division of the du Pont Company at Wilmington, after spending several years in the operating department of the Grasselli Powder Company, Cleveland.

OBITUARY

Donat Agache, president of the Etablissements Kuhlmann, the large French chemical cartel, died on April 23 at Neuilly-sur-Seine at the age of 47. Besides many other executive and honorary posts M. Agache held the presidency of the Société de Chimie Industrielle.

Rudolph Breves, president of the Waukegan Chemical Company, died at the age of 62 on the afternoon of April 25 after a lingering illness. Dr. Breves was a native of Osterwald, Germany, and received a chemical and pharmaceutical education at several cities abroad as well as in Chicago and New York. His career here, after successive industrial chemical positions in Germany, began as chief chemist of the Egyptian Lacquer Manufacturing Company from 1899 to 1915.

Linden R. Adkins, chief chemist of the Rochester works of the Vacuum Oil Company, died suddenly at his home in that city on April 16. He was born in Little Falls, N. Y., in 1880, and was graduated from Oberlin University in 1904. After graduation he found employment with the Vacuum Oil Company at Rochester, N. Y.

Charles T. Nolan, manager of the linseed department of the National Lead Company, with whom he had been connected for 29 years, died on May 11 of heart disease. He was 57 years old and was chairman of the flax committee of the National Paint, Oil and Varnish Association.

William P. Hammond, of the patent law firm of Hammond & Littell, died suddenly of a heart attack on April 19 in New York. He had practiced patent law involving chemical engineering processes for over twenty years, specializing in the field of filtration.

Martin Nilsson, in charge of chemistry and research for the Fleischmann Manufacturing Company, died on April 10 in New York in his 56th year. A native of Sweden, he had studied in Berlin and Belgium, and came to this country in 1905. He joined the Fleischmann organization in 1912.

Ralph Kilmer, vice-president in charge of sales for the Pfaudler Company, Rochester, N. Y., died on April 5 of heart failure following an attack of pneumonia from which he was apparently recovering. Mr. Kilmer was only 40 years of age, and had but recently been promoted to his executive position after an outstanding career in contacts with chemical, food and allied industries.

RALPH KILMER

Charles E. Carpenter, president of E. F. Houghton & Company, Philadelphia, died of heart disease on April 7 at Miami Beach in his 67th year.

George O. Bassett, chemical engineer in the research department of the Bell Telephone Laboratories, New York, died on March 21 in Orange, N. J., after an operation. Mr. Bassett, a native of Topeka, Kan., was connected with his company for 37 years, having joined it soon after graduation from the Massachusetts Institute of Technology.

John A. Mandel, professor of chemistry at New York University, died in his 63rd year at his home in Yonkers on May 5. Professor Mandel was a native of Sweden, but gained his education in Berlin and New York.

Frank B. Toombs, sales manager and a founder of the Chicago Steel & Wire Company, died on April 15 of pleurisy at the age of 36.

INDUSTRIAL NOTES

The West Virginia Pulp & Paper Company has removed its general offices to the New York Central Building, 230 Park Avenue, New York.

The Chrome Steel Works, Carteret, N. J., have been absorbed by the Canda Gayley Steel Corporation, with C. E. Meissner in the post of sales manager.

The American Engineering Company, Philadelphia, Pa., has transferred its New York office to 40 West 40th Street.

The Boston Woven Hose & Rubber Company has placed H. S. Merrill in charge of the office at Denver, Colo., whence C. W. Stanton moves to the Ohio territory with offices at Cincinnati.

Harbison-Walker Refractories Company announces R. M. Sievers as the new district sales manager for St. Louis, Mo.

Baker & Company, Inc., Newark, N. J., has acquired the assets of the R. & H. Platinum Works, Inc., New York and Perth Amboy, N. J., whose business will be conducted by F. A. Croselmire at 30 Church Street, New York.

The Griscom-Russell Company has established a new sales office at the Union Trust Building, Cincinnati, Ohio.

The Duraloy Company, Pittsburgh, Pa., has opened a district office at 888 Arcade Building, Cleveland, Ohio, under J. H. Hobbs.

The Patterson Foundry & Machine Company has appointed R. E. Rullman manager of its new Chicago office at 205 West Wacker Drive.

The Air Reduction Sales Company now has its purchasing department located at 342 Madison Avenue, New York.

Kelp Products Company is the new name of Thornley & Company, located at San Diego, Calif.

The Diamond Alkali Company now has its offices located at 436 Seventh Avenue, Pittsburgh, Pa.

The Philadelphia Gear Works has opened a new branch office at Farmers Bank Building, Pittsburgh, Pa.

The Edward Valve & Manufacturing Company, East Chicago, Ind., is now represented in Baltimore, Md., by D. C. Elphinstone, Inc., 120 South Calvert Street.

The Weaver Brothers Company, organized four years ago as subsidiary to the Ferro Enamel Supply Company, has moved its operations from Clinton to Adrian, Mich.

The Koppers Construction Company, Pittsburgh, Pa., has moved its offices into the new Koppers Building, at Grant Street and 7th Avenue.

The Northern Equipment Company, Erie, Pa., has appointed R. L. Sittinger, 80 Federal Street, Boston, Mass., and Peacock Brothers, Ltd., Montreal, Canada, representatives for the Copes system.

The Texas Gulf Sulphur Company has removed its general offices to the New York Central Building, 75 East 45th St., New York.

The Roller-Smith Company, New York, has appointed representatives as follows: C. P. Lahr, 401 National Bank of Commerce Building, St. Louis, Mo.; J. Brown, Jr., 701 Kittridge Building, Denver, Colo.; J. C. McDougall, Alaska Building, Seattle, Wash.

The Ashcraft-Wilkinson Company, Atlanta, Ga., has been appointed exclusive representative for the Duval Texas Sulphur Company, Houston.

Manganese Steel Forge Company has established an office at 623 Union Trust Building, Cleveland, Ohio, with P. M. Hobbs in charge.

Industrial Chemical Sales Company Inc., is now located at the New York Central Building, 230 Park Avenue, New York.

The Pangborn Corporation, Hagerstown, Md., has acquired the assets of the Universal Shot & Sand-Blast Manufacturing Company, Hoboken, N. J.

The Brown Instrument Company has appointed C. H. Kerr vice-president and general manager, and G. W. Keller vice-president and sales manager.

The Reading Iron Company, Reading, Pa., has established an office at 402 Mutual Building, Kansas City, Mo., under H. D. Pollard.

Chester H. Jones has opened an office at 52 Vanderbilt Ave., New York, to serve as eastern representative of the Fansteel Products Company in the commercial development of tantalum, molybdenum, tungsten and columbium.

MARKET CONDITIONS *and* PRICE TRENDS

Synthetic Organic Chemicals Attain Market Prominence

Gains in Output of Aliphatic Compounds Feature Productive Activities

PRELIMINARY figures were issued recently by the U. S. Tariff Commission showing that domestic production of coal-tar products in 1928 had made notable gains. The output of coal-tar dyes was approximately 96,600,000 lb., or a gain of 1,400,000 lb. over the output of 1927. The production of vat dyes in 1928 established a new record with a total of more than 6,300,000 lb. as compared with 5,961,688 lb. in 1927. Production and sales of dyes and other finished coal-tar products for 1928 exceeded the totals for any year since 1918. Increases over 1927 were reported for coal-tar crudes, synthetic medicinals, and synthetic resins.

The report also included production figures for some of the synthetic organic chemicals not of coal-tar origin. In the absence of figures for the entire industry it is not possible to make definite comparisons with 1927 but if the data available may be construed as a cross-section of the industry, the total output will compare favorably with that for the preceding year.

IN the report for 1927 it was stated that expansion in the domestic production of aliphatic organic compounds in the last few years had been unparalleled. It was further stated that the increase in production of aliphatic compounds from 21,500,000 lb. in 1921 to more than 13 times that quantity in 1927 was in sharp contrast to the increase in finished coal-tar chemicals from 51,500,000 lb. to less than 3 times that quantity.

Raw materials used in the manufacture of these compounds are available in ample supply from domestic sources. They include natural gas, petroleum, carbide, coke, glycerine, turpentine, pine oil, corn, oat hulls, and wood cellulose. The finished products find outlets as solvents, medicinals, flotation agents, in perfumes, flavors, rubber accelerators, explosives, and photographic developers.

With no dearth of raw materials and with the increased use of solvents and accelerated production in all consuming industries it becomes evident that production of aliphatic organic compounds was larger in 1928 than in 1927, which is equivalent to saying that 1928 production was of record proportions. With the development of other new synthetic organic chemicals and with expansion in production of those which have already been commercially established, it is equally evident that the group as a whole recorded progress in 1928 if indeed the rate of progression was not up to that set in the years immediately preceding.

THE comparative position of the synthetic organic chemical industry in 1928 may be visualized by comparison of statistics available for that year with those for 1927. Production of amyl acetate was 4,290,000 lb. in 1928 and 2,421,301 lb. in 1927. Sales were 4,458,000 lb. and 1,677,523 lb. respectively. The gain in production during the year figures out at more at 77 per cent.

Somewhat similar conditions are found in amyl alcohol. The output last year reached a total of 4,801,000 lb., or a more than 77 per cent gain over the 1927 total of 2,703,844 lb.

Butyl acetate did not show such a large percentage of increase but a 14 per cent gain is indicated by the relative production figures of 30,030,000 lb. and 26,304,243 lb.

Carbon tetrachloride, the production of which had fallen off in 1927, again came to the front in 1928, with an increased output which was reported at 19,765,000 lb., or a gain of approximately 19 per cent over the 1927 production of 16,550,026 lb.

Both production and sales of ethyl acetate showed a healthy growth last year. Consuming demand was reported as steadily active and accounts for the increase in production from 49,203,156 lb. in 1927 to 58,578,000 lb.

The Tariff Commission in the last two years did not include in its report production figures for synthetic methanol but private reports have placed the output last year at a large total and this is substantiated by the fact that plant capacities of producing companies had been expanded.

Market reports throughout 1928 had called attention to the fact that unusually heavy buying was being met in the case of formaldehyde. The accuracy of these reports was verified by the sales and production data contained in the census report. Production of formaldehyde last year amounted to 38,718,000 lb. as compared with 29,920,072 lb. in the preceding year.

Xanthates have been finding a wider outlet in recent years as flotation agents and naturally this has had a bearing on the trend of production. Domestic production last year was reported at 5,458,000 lb., which compares with 4,700,610 lb. reported for 1927.

During the latter part of 1928, synthetic acetic acid of domestic origin reached the market and the output was reported to have been readily absorbed. No data regarding the volume of production are available, but it is expected that this commodity will assume greater market importance in the near future.

Synthetic Organic Chemicals of Non-Coal-Tar Origin Production and Sales 1921-1927

	Production	Sales	
	Lb.	Lb.	Value
1921	21,545,186	16,761,096	$7,226,068
1922	79,202,155	60,494,494	11,964,074
1923	90,597,712	67,727,067	13,875,521
1924	115,817,865	85,933,461	20,604,717
1925	156,878,013	114,626,209	23,632,770
1926	214,842,513	168,712,158	29,719,270
1927	280,992,825	201,548,089	36,600,628

Synthetic Organic Chemicals of Non-Coal-Tar Origin, 1928-1927

	1928			1927		
	Sales		Production	Sales		Production
Product	Lb.	Value	Lb.	Lb.	Value	Lb.
Amyl acetate and sec amyl acetate	4,458,000	$1,092,000	4,290,000	1,677,523	$459,150	2,421,301
Amyl alcohol and sec amyl alcohol	2,705,000	646,000	4,801,000	.....	.....	2,703,844
Aubepine (anisic aldehyde)	5,600	17,800	5,800			
Butyl acetate (n and sec)	20,776,000	3,785,000	30,030,000	13,565,527	2,796,919	26,304,243
Butyl propionate	3,112,000	711,000	3,040,000	1,720,036	535,278	1,731,895
Carbon tetrachloride	19,699,000	1,276,000	19,765,000	16,969,652	1,049,759	16,550,026
Citronellol	1,700	4,300	2,100	.....	.....	.....
Ethyl acetate (85% purity)	43,911,000	4,745,000	58,578,000	36,505,506	3,909,804	49,203,156
Ethyl butyrate	65,000	58,000	69,000	.....	.....	.....
Ethyl ether, USP	4,623,000	1,482,000	5,933,000	4,695,699	1,432,321	5,855,462
Ethyl isolvalerate	700	2,000	800	.....	.....	.....
Ethyl nitrite	32,000	20,000	34,000	33,317	25,342	34,099
Ethyl oenanthate	2,400	3,700	3,400	4,415	7,773	5,413
Formaldehyde (40% purity)	27,934,000	2,492,000	38,718,000	24,597,367	2,256,534	29,920,072
Gallic acid	.....	.....	433,000	.....	.....	515,876
Geranyl acetate	1,400	4,200	1,400	.....	.....	1,204
Hexamethylenetetramine	.....	.....	1,662,000	.....	.....	1,315,213
Ionone	33,000	125,000	34,000	28,517	132,989	32,044
Isoamyl butyrate	12,000	13,000	13,000	9,237	11,187	10,035
Isoamyl formate	400	400	400	.....	.....	.....
Linalyl acetate	670	4,400	720	435	2,894	487
Pyrogallol (Pyrogallic acid)	.....	.....	142,000	166,472	203,878	.....
Rhodinol	2,600	34,000	2,500	1,934	22,548	2,237
Terpinyl acetate	9,000	11,000	9,000	11,221	11,943	11,287
Vanillin	325,000	1,992,000	282,000	316,038	2,070,775	301,251
Xanthates	5,516,000	628,000	5,458,000	4,567,492	489,226	4,700,610

MARKET APPRAISAL OF CHEMICAL INDUSTRY

American Commercial Alcohol Corp. in statement to New York Stock Exchange for quarter ended March 31, 1929, reports net profit of $245,883 after interest, depreciation, federal taxes, etc., equivalent after dividend requirements on 7 per cent preferred stock, to $2.04 a share on 107,956 average no-par shares of common stock outstanding during the quarter and to $1.62 a share on 135,877 common shares outstanding at end of the quarter.

Report of Certain-teed Products Corp. for quarter ended March 31, 1929, shows net loss of $583,575 after depreciation, depletion, interest, federal taxes, etc. This compares with net profit of $3,043 in first quarter of 1928.

Profit of the New Jersey Zinc Co. for the first quarter of 1929 was reported at $2,026,934, equal to $1.03 a share as compared with earnings of 84c. a share for first quarter of 1928.

Atlas Powder Co. reports for quarter ended March 31, 1929, net income of $523,089, after depreciation, federal taxes, etc., equivalent after dividend requirements on 6 per cent preferred stock, to $1.48 a share on 261,438 no-par shares of common stock. This compares with $361,991, or 87c. a share on the common in first quarter of 1928.

The Corn Products Refining Company for the quarter ended on March 31 reports a net income of $3,435,404 after interest, depreciation and federal taxes, equivalent after 7 per cent preferred dividends to $1.18 a share earned on 2,530,000 shares of common stock. This compares with $2,714,707, or 90c. a common share, in the first quarter of 1928.

The Newport Co. and subsidiaries report for quarter ended March 31, net profit of $355,930 after interest, depreciation, and federal taxes. This is equivalent, after allowance for dividend requirements, to $1.03 a share earned on 251,250 shares of no-par common stock.

Industrial Silica Corp., representing merger of 14 independent companies, has completed its organization. Capital structure consists of $1,000,000 6 per cent first mortgage bonds; $1,500,000 preferred stock $100 par value, paying 6½ per cent, and 150,000 shares of common stock of no-par value.

Report of Anglo-Chilean Consolidated Nitrate Corp. and subsidiaries for year ended December 31, 1928, shows deficit of $2,469,332 after taxes, depreciation and interest, including interest on debenture stock and debenture bonds but before depletion, against deficit of $3,813,377 in 1927.

Price Range Since Jan. 1 High	Price Range Since Jan. 1 Low	Stock	Price Range in April: Apr. 1	High	Low	Apr. 30
121⅛	95⅛	Air Reduction	102⅛	121⅛	95⅛	120⅛
11⅛	7⅛	Ajax Rubber	8⅛	8⅛	7⅛	7⅛
305⅛	241	Allied Chemical	270	292	266⅛	283⅛
125	120⅛	Allied Chemical, pf	121	125	120⅛	124
23⅛	14⅛	Am. Ag. Chemical	17⅛	18⅛	15⅛	16⅛
73⅛	53⅛	Am. Ag. Chemical, pf	60⅛	61⅛	53⅛	55⅛
80	50	American Cyanamid, B	58⅛	61⅛	53⅛	61⅛
10	6⅛	Am. Hide & Leather	....	7⅛	6⅛	7
81⅛	55⅛	American Metal	62⅛	64⅛	57⅛	59
40⅛	26⅛	Am. Solvents & Chemical	36	36⅛	29	29⅛
45⅛	33	Anglo-Chile Nitrate	44⅛	44⅛	37⅛	39⅛
110⅛	36⅛	Archer-Daniels-Midland	41	41	36⅛	37⅛
27⅛	19	Ass. Dyeing & Printing	20⅛	22⅛	20	20⅛
115	90	Atlas Powder	96	99⅛	90	....
28⅛	20	Beacon Oil	22⅛	23⅞	22	22⅛
101	81⅛	Beechnut Packing	....	95⅛	85	....
89⅛	78⅛	Bon Ami, A	80	85	80	83⅛
109⅛	89⅛	Bristol-Myers	94⅛	99⅛	89⅛	....
30	26⅛	California Petroleum	....	30	27	....
57⅛	41⅛	Celanese	45⅛	48⅛	42⅛	42⅛
122	104⅛	Celanese, pf	115	122	110	115
28⅛	16⅛	Certain-teed	19	25⅞	16⅛	22⅛
50	40⅛	Chickasha Cotton Oil	41⅛	42⅛	40⅛	42⅛
360	225⅛	Commercial Solvents	260	360	258⅛	359
101⅞	82	Corn Products	83⅛	101⅛	82	97⅛
69⅛	49	Davison Chemical	55⅛	59⅛	50	58⅛
64	52	Devoe & Raynolds	55⅛	56⅛	52	54⅛
115⅛	112	Devoe & Raynolds, pf	114⅛	115	114⅛	115
198⅛	155⅛	Du Pont	180	185⅛	175	180
119	115⅛	Du Pont, 6 pc. db	117⅛	119	117⅛	117⅛
194⅛	170	Eastman Kodak	....	183⅛	170	179⅛
309	220⅛	Firestone Tire	264⅛	309	249	291⅛
20⅛	10⅛	Fisk Rubber	13⅛	13⅛	10⅛	11⅛
84⅛	65⅛	Fleischmann Co	72	73⅛	65⅛	67⅛
54⅛	38	Freeport Texas	45⅛	47⅛	44	45
50⅛	36⅛	Glidden Co	42⅛	50⅛	41	49
106⅛	103⅛	Glidden Co., pf	104	106⅛	103⅛	....
82	54⅛	Gold Dust	62	67⅛	64⅛	64⅛
105⅛	81	Goodrich Co	92⅛	92⅛	82⅛	82⅛
109	80⅛	Houston Oil	104⅛	109	92	96
135	110	Industrial Rayon	116	120⅛	112	....
17⅛	12⅛	Int. Ag. Chemical	12⅛	14⅛	12⅛	....
88⅛	75	Int. Ag. Chemical, pf	....	80⅛	75	....
35⅛	27⅛	International Paper	32	35⅛	29	30⅛
90⅛	55⅛	International Salt	76⅛	87	74	80
23⅞	11	Kelly-Springfield	16⅛	17⅛	15	17
25	18	Lee Rubber & Tire	19⅛	20	18	18⅛
68⅛	52⅛	Lehn & Fink	55	58	53	56⅛
220⅛	179	Libby-Owens	195	195	180⅛	....
113⅛	71⅛	Liquid Carbonic	77	89⅛	75⅛	85⅛
51⅛	50	Mathieson Alkali	....	51⅛	50	....
27	16⅛	Monsanto Chemical	....	17	16⅛	....
55⅛	33	Nat'l Dist. Products	43⅛	54⅛	40	50⅛
173	132	National Lead	154⅛	157⅛	144	....
335	279⅛	New Jersey Zinc	....	335	310	....
74⅛	64⅛	Ohio Oil	68	73⅛	67	70⅛
98⅛	81	Owens Bottle	93	93	84	....
80⅛	66⅛	Palmolive Peet	72	74⅞	66⅛	....
47	37⅛	Phillips Petroleum	42⅛	44⅛	40⅛	42⅛
76⅛	64	Pittsburgh Plate Glass	67⅛	68	65	....
85	63⅛	Pratt & Lambert	....	75	71⅛	....
28⅛	23⅛	Pure Oil	27⅛	28⅛	25	27⅛
90	81	Sherwin-Williams	84⅛	90	82	90
48⅛	23⅛	Silica Gel	40⅛	42⅛	36⅛	39
45	35⅛	Sinclair Oil	40	41	37	39⅛
46⅛	32⅛	Skelly Oil	36⅛	46⅛	35⅛	44⅛
81⅛	64	Standard Oil, Cal	77⅛	80⅛	74	78⅛
61⅛	48	Standard Oil, N. J	57⅛	61⅛	55⅛	58⅛
45⅛	38	Standard Oil, N. Y	42⅛	45	41⅛	43
9⅛	4⅛	Standard Plate Glass	5⅛	5⅛	5	5⅛
68⅛	57	Sun Oil	62	64	59	61⅛
18	15	Swan & Finch	....	17	15	....
20⅛	16	Tennessee Copper & Chemical	18⅛	20⅛	16	20
68⅛	57⅛	Texas Corp	66⅛	68⅛	62⅛	65⅛
85⅛	72⅛	Texas Gulf Sulphur	79⅛	85⅛	76⅛	83⅛
37⅛	27⅛	Tidewater Oil	33⅛	35⅛	31⅛	34⅛
550	365	Tubize Silk	390⅛	395	365	380
274⅛	196⅛	Union Carbide	218	247⅛	211	245⅛
54⅛	46	Union Oil, Cal	51⅛	54⅛	49⅛	50⅛
114	93	United Piece Dye	....	103⅛	103⅛	....
171	128	U. S. Ind. Alcohol	142⅛	171	138	171
35⅛	20	U. S. Leather	23⅛	26	22⅛	23⅛
65	42	U. S. Rubber	57⅛	58⅛	51⅛	55⅛
133⅛	105⅛	Vacuum Oil	126⅛	129⅛	121⅛	126
116⅛	83⅛	Vanadium Corp	96	100⅛	90	96⅛
94⅛	82	Vick Chemical	89⅛	92	87⅛	92
24⅛	15⅛	Va. Ca. Chemical	17⅛	17⅛	15⅛	16⅛
97⅛	89	Va. Ca. Chemical, pf	....	90	89	....
48	37	Wesson Oil	41⅛	43⅛	37⅛	43
13⅛	8⅛	Wilson & Co	10	10	8⅛	9⅛

ECONOMIC INFLUENCES *on production and consumption of* CHEMICALS

Movement of Chemicals Surpasses That of Last Year

Trade Reports Place Increase for Second Quarter at 7.5 Per Cent

ACTIVITIES in the producing and consuming branches of the chemical industry are holding up to standards considerably above those experienced in the corresponding period of 1928. At the meeting of the Atlantic States Shippers Advisory Board, held last month, car requirements for the movement of chemicals in the Atlantic States section of the country indicated an increase of 7.5 per cent for the second quarter of the year as compared with the April-June period of 1928. Car requirements for some of the commodities into which chemicals enter reported increases for the same period; for petroleum and its products, 10 per cent; paper and pulp, 14 per cent; tanning materials, 15 per cent; glass containers, 4 per cent; paints, oils, and varnishes, 4 per cent, and textiles, 2 to 10 per cent, according to classifications. On the other hand deliveries of fertilizers for the period are expected to show a decline of 0.7 per cent.

According to statistics compiled by the Rubber Association of America, consumption of crude rubber in April exceeded that for March and created a new high record for monthly consumption. Consumption in April was 47,521 tons, while that for March, which held the record, was 44,287 tons. Consumption in April, 1928, amounted to 32,450 tons.

DATA covering manufacturing operations in branches of chemical production or in chemical consuming lines are available for March and show the following comparisons with March, last year:

	March 1928	March 1929
Production		
Acetate of lime, 1,000 lb.	13,022	12,082
Alcohol, ethyl, 1,000 gal.	11,050	14,858
Methanol, crude, gal.	707,460	714,266
Methanol, ref., gal.	442,023	494,435
Turpentine, wood, bbl.	6,647	7,059
Rosin, wood, bbl.	35,148	37,361
Turpentine, gum, receipts, bbl	5,624	8,440
Rosin, gum, receipts, bbl.	25,544	37,733
Byproduct coke, 1,000 tons	4,065	4,613
Plate glass, 1,000 sq.ft.	11,951	13,144
Glass containers, 1,000 gross	2,570	2,574
Arsenic, crude, ton.	1,076	1,307
Arsenic, refined, ton.	688	945
Superphosphate, ton.	352,691	282,504
Chemical wood pulp, ton.	228,692	230,838
Automobiles, cars, no.	371,821	513,266
Automobiles, trucks, no.	41,493	69,559
Petroleum, refined, 1,000 bbl.	72,428	80,708
Leather in process of tanning, sole and belting, 1,000 lb.	87,299	79,524
Upper, 1,000 sq.ft.	141,386	133,333
Consumption		
Cottonseed oil, bbl.	372,600	273,000
Cotton, bales	581,325	632,808
Wool, grease equiv., 1,000 lb.	46,757	48,656

The above figures, while not sufficiently inclusive to depict productive activities in the entire chemical industry, nevertheless cover a range of consuming industries sufficiently embracing to add weight to reports of an enlarged output of chemicals for the period mentioned.

Another index of manufacturing operations is found in the report of *Electrical World* which is based on consumption of electrical energy. The report places general manufacturing activities for April on a record plane, surpassing the previous high month of September, 1928, by 1.1 per cent and topping April last year by 14.3 per cent.

There is some doubt about the ability of automobile producers to maintain the high rate of production which has featured the year to date. Moreover, current reports are to the effect that stocks of cars in dealers' hands are becoming unwieldy. As the automobile industry draws heavily upon a varied line of chemicals, it is evident that any material change in the former would be reflected in the movement of chemicals. Seasonal influences also will play more of a part in slowing down demand for chemicals in the near future. The position of consuming industries in general, however, is favorable for the maintenance of active operations among chemical producers and there are no indications that the gains in output recorded so far this year will be lost because of later developments.

THE general index of industrial production during March, after allowance for seasonal conditions, showed gains over both the preceding month and the corresponding period of 1928, according to the computation of the Federal Reserve Board. The principal increases over March, 1928, in manufacturing, occured in the output of automobiles, iron and steel and nonferrous metals. Declines from last year were registered in food products and in the output of leather and shoes. Mineral production, after adjustment for seasonal conditions, showed a decline from the preceding month but was larger than a year ago.

Stocks of commodities held at the end of March were greater than a year ago, but showed a decline in the preceding month. The principal increase over last year was shown in raw materials.

The general index of unfilled orders showed gains over both the previous month and March, 1928. Forward business for all groups was larger than in February except textiles, whose unfilled orders declined. As compared with a year ago, all groups for which data are available showed larger unfilled orders in March. The greatest relative increase over last year occurred in unfilled orders for transportation equipment, principally railroad.

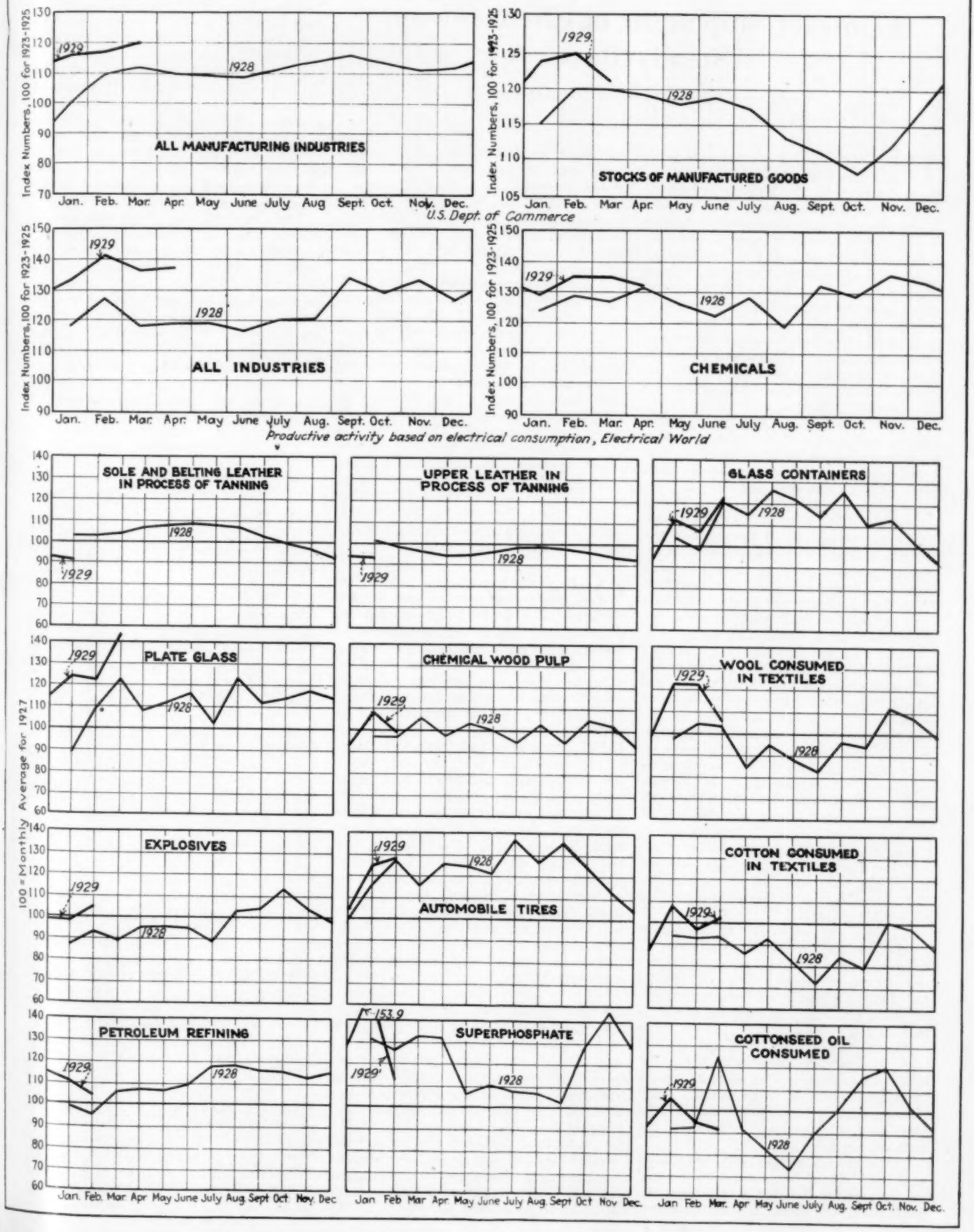
FOREIGN TRADE in chemicals, likewise, has made a favorable showing. For the first quarter of the year, chemicals and related products to the value of $38,751,675 were shipped out of the country as compared with $34,422,025 for the first quarter of 1928. The increase is widely divided and holds true for coal-tar products, medicinal and pharmaceutical preparations, industrial chemicals, paints, pigments, and varnishes, fertilizer and fertilizer materials, explosives, and soap and toilet preparations. In the industrial chemical group, the soda compounds are prominent with exports of 166,751,652 lb. for the first quarter of 1929 in comparison with 120,504,803 lb. for the corresponding period of 1928. Exports of sulphur have been running heavy and amounted to 168,864 tons for the quarter as against 129,791 tons for the preceding year.

Import trade for the quarter was lower than a year ago, the valuation being $41,753,939 and $40,419,615 for 1928 and 1929, respectively. A large part of this falling off is accounted for by declines in importations of coal-tar products. In the industrial chemical group, imports for the first quarter of this year were valued at $7,226,871 as against $5,123,714 in 1928. Notable among the increases in this group was acetic acid, which has been coming in from Canada in large volume.

Domestic Output of Potash Increased in 1928

POTASH produced in the United States in 1928 amounted to 104,129 short tons of potassium salts containing 59,910 short tons of potash (K_2O), according to the United States Bureau of Mines. Sales by producers amounted to 105,208 tons of potassium salts containing 60,370 tons of K_2O. The potash materials of domestic origin, sold by producers in 1928, were valued at $3,029,422 f.o.b. plants. About 6,260 tons of potassium salts with an available content of 2,100 tons of K_2O, remained in producers' stocks December 31, 1928. The output increased 35.5 per cent in gross weight with an increase of 38 per cent of K_2O content. The sales of salts increased 11 per cent with an increase of 22 per cent in K_2O content. The total value of the sales increased 24 per cent. Stocks remaining in the hands of producers at the end of 1928 were 14 per cent less than at the end of 1927.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



Contract Shipments of Chemicals on Steady Basis

Trading in Spot Market Maintained at Seasonal Standard

DISTRIBUTION of chemical products since the first of the year has been featured by the large withdrawals against existing contracts. This emphasizes the fact that contract placements for delivery over 1929 were larger than usual and it illustrates the trend in recent years of consumers covering a large part of their requirements ahead. Withdrawals in the last month have been held on a steady basis and the tonnage involved has been large enough to demonstrate that both production and consumption of chemicals have surpassed the totals for the corresponding period of the preceding year.

Business placed in the spot market shows indications of a slight recession as complaints are heard to the effect that inquiries have been less numerous than they were a short time ago.

Considerable interest has been shown in trade circles relative to the possible effect on the market of revisions in the tariff schedule. The changes as at present proposed appear to have but little market significance with the exception that the influence of foreign markets may be lessened as a result of some upward changes in import duties.

THE market for alcohol has strengthened since the first of the month and in some quarters deliveries in the latter part of the year are carrying an additional premium. In other quarters, current quotations are holding good on later shipments and the market appears to be more competitive than has been the case in several months. Butyl alcohol has been offered freely and the market has worked fractionally in buyers' favor. Incidentally another consolidation of alcohol-producing companies has been effected and the reduction in the number of independent producers is regarded as a stabilizing factor.

Alkalies are enjoying an unusually good year and increased production is being absorbed without any apparent accumulation of stocks. Export demand for alkalies is aiding in the general distribution and has been running ahead of that of a year ago.

Trading in arsenic is about normal with the arsenate industry slow to take hold. The movement of calcium arsenate has not come up to expectations and the large potential market which was visualized a few years ago never has been realized.

Producers of nickel salts have been well sold ahead for some months and the surplus for the spot market remains small enough to cause difficulty in securing sizable quantities. The active call for these salts has been one of the features of the market.

In the coal-tar list, a good demand is heard for the majority of the products with benzol, toluol, solvent naphtha, and xylol firmly held and largely sold ahead.

Wood distallation chemicals are holding a steady tone. Latest available statistics covering March record an enlargement of output for acetate of lime and crude and refined methanol. Shipments from producing plants also were larger and while there no longer is a stringency in stocks, the holdings in sellers' hands are not large and a steady price tone continues. Other solvents are very active. In fact the solvent group represents one of the most active branches of the chemical industry at present. The lacquer trade is drawing heavily upon the solvent supply and other consuming trades appear to have increased their requirements.

ONE of the important developments in the recent market was the announcement of a new price schedule for potash salts. Sales representatives of foreign producers had held the market on a steady basis for a long time but a higher level was put into effect on May 1. The new prices are as follows: Muriate, 80 to 85 per cent, basis of 80 per cent, $36.75 per ton in bags and $35.15 per ton in bulk; sulphate, 90 to 95 per cent, basis of 90 per cent, $47.75 per ton in bags and $46.15 per ton in bulk; potash-magnesia sulphate, 48 to 53 per cent, basis of 48 per cent, $27.50 per ton in bags and $25.90 per ton in bulk; manure salts, 30 per cent, $21.95 per ton in bags and $18.95 in bulk; manure salts, 20 per cent, $15.50 per ton in bags and $12.50 per ton in bulk; kainit, 14 per cent minimum, $12.60 per ton in bags and $9.60 per ton in bulk; and kainit, 12.4 per cent minimum, $12.10 per ton in bags and $9.10 per ton in bulk.

THE Department of Commerce announces that the factory production of fats and oils (exclusive of refined oil and derivatives) during the three-month period ended March 31, 1929, was as follows: Vegetable oils, 884,021,721 lb.; fish oils, 19,920,596 lb.; animal fats, 656,500,156 lb.; and greases, 100,606,316 lb.; a total of 1,661,048,789 lb. Of the several kinds of fats and oils covered by this inquiry, the greatest production, 536,920,852 lb. appears for lard. Next in order is cottonseed oil with 522,824,575 lb.; linseed oil with 200,122,722 lb.; tallow with 118,340,413 lb.; cocoanut oil with 90,175,368 lb. and corn oil with 36,350,888 lb.

The production of refined oils during the period was as follows: Cottonseed, 500,415,614 lb.; cocoanut, 83,755,347 lb.; peanut, 3,381,316 lb.; corn, 36,317,998 lb.; soya-bean, 2,367,175 lb.; and palm-kernel, 3,985,123 lb. The quantity of crude oil used in the production of each of these refined oils is included in the figures of crude consumed.

The report also contains data on the consumption of vegetable oils for the quarter. With but few exceptions, the totals for 1929 are considerably above those for the corresponding period of last year. The large increase in consumption of cottonseed, coconut, palm, and sulphur oils is regarded as proof of heavier buying by the soap trade. Greater activity among paint and varnish manufacturers is assigned as the reason for the larger disappearance of linseed and china wood oils.

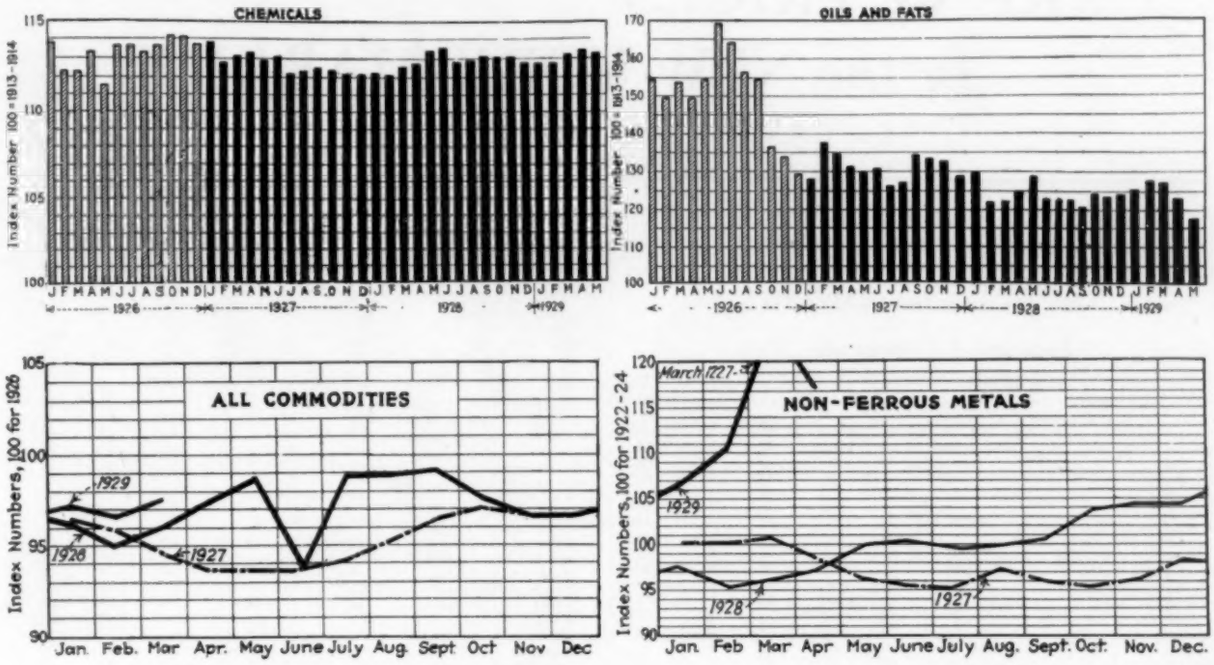
Imports of Chemicals

	March 1928	March 1929
Dead or creosote oil, gal.	7,278,704	5,048,110
Pyridine, lb.		2,710
Coal-tar acids, lb.	4,500	107,927
Coal-tar intermediates, lb.	72,383	219,794
Arsenic, white, lb.	1,625,072	2,172,331
Acid, acetic, lb.		3,572,733
Acid, farmic, lb.	216,381	552,348
Acid, oxalic, lb.	73,381	47,445
Acid, sulphuric, lb.	1,144,855	
Acid, tartaric, lb.	23,520	129,472
Ammonium chloride, lb.	921,029	1,070,773
Ammonium nitrate, lb.	1,101,879	651,410
Barium compounds, lb.	2,283,371	238,283
Calcium carbide, lb.		156,000
Cobalt oxide, lb.	35,700	50,365
Copper sulphate, lb.	398,556	137,634
Bleaching powder, lb.	262,854	143,342
Glycerin, crude, lb.	108,396	3,084,372
Glycerin, ref., lb.	191,664	730,355
Iodine, lb.	45,692	70,698
Magnesium compounds, lb.	1,518,360	1,411,834
Potassium cyanide, lb.	21,903	
Potassium carbonate, lb.	1,834,351	1,934,354
Caustic potash, lb.	624,461	787,472
Cream of tartar, lb.	5,600	6,160
Potassium chlorate, lb.	892,144	1,248,669
Sodium cyanide, lb.	1,478,004	1,622,749
Sodium ferrocyanide, lb.	240,833	83,802
Sodium nitrite, lb.	22,423	40,318
Sodium nitrate, ton	177,187	101,297
Sulphate of ammonia, ton	3,292	3,470

Exports of Chemicals

	March 1928	March 1929
Benzol, gal.	2,403,209	4,129,809
Acid, sulphuric, lb.	727,558	704,726
Acid boric, lb.	598,973	586,066
Other acids, lb.	1,313,704	2,581,300
Methanol, gal.	41,232	28,478
Glycerin, lb.	246,593	299,729
Acetone, lb.	495,716	400,804
Formaldehyde, lb.	153,537	273,332
Ammonium compounds, lb.	244,398	45,637
Aluminum sulphate, lb.	3,875,021	2,992,721
Acetate of lime, lb.	2,036,754	17,192
Calcium carbide, lb.	519,913	484,346
Bleaching powder, lb.	1,302,149	811,710
Copper sulphate, lb.	1,011,575	702,423
Potassium compounds, lb.	269,782	440,175
Sodium bichromate, lb.	576,317	202,511
Sodium cyanide, lb.	196,411	458,456
Borax, lb.	14,976,848	12,836,068
Sodium carbonate, lb.	5,549,107	4,205,540
Sodium silicate, lb.	1,783,775	6,329,594
Caustic soda, lb.	7,963,032	12,447,982
Other sodas, lb.	4,643,682	17,259,675
Sulphate of ammonia, ton	8,978	19,798
Sulphur, ton.	47,296	55,712

CHEM. & MET. *Weighted Indexes of* PRICES



U. S. Dep't of Labor — *Engineering & Mining Journal*

New Import Duties Loom as Factor on Chemical Prices

UNQUESTIONABLY the most influential factor at present bearing upon possible changes in prices for several chemicals is the drafting of a new tariff schedule in which import duties on many chemicals will have a changed status. The bill as it stands at present—and later revisions in the chemical schedule probably will be limited—proposes higher duties on several chemicals in which competition is keen between those of domestic and foreign origin. In the acid group a greater advantage will rest with domestic producers and on the theory that current sales prices have settled at levels dictated by competition it would be logical to deduce that a portion of the increase in duties would be made use of to meet competition, thus leaving a margin which could be added to sales quotations. Competition from foreign producers of chromic acid should be less keen when the new rates become effective and the advantage of producing nitric acid at low costs should be lost to foreign markets as far as finding an outlet in domestic markets is concerned.

Higher producing costs for industrial alcohol are forecast if the proposed duty of 2.19c. per gallon becomes effective for blackstrap molasses. Possibly this proposal may be further revised but the situation surrounding alcohol is basically firm and buyers who do not cover requirements for distant positions at prevailing offers can hardly be holding off because of hopes that they will obtain more favorable prices later on.

Outside the tariff influence there has been nothing new upon which to base the trend of values and the price movement for the near future appears to rest, more than on anything else, upon the general state of business activity. Should the hot weather period bring a slowing up in manufacturing lines, the market might easily respond by showing an easier price trend.

VEGETABLE oils likewise are coming under the influence of tariff changes. An increase of 16c. per bushel is proposed for linseed. As crushers must compete in foreign markets in the sale of oil cake it follows that a greater part of the higher cost for seed must be written off to oil. On this basis the cost of producing oil would be increased nearly six and one-half cents per gallon, taking two and one-half gallons of oil as the average yield from one bushel of seed.

THE status of coconut oil is not changed except as it may be influenced by the possible reduction in importations of soya bean, sesame, and edible palm kernel oils. Palm kernel oil so far as its use in its crude state is concerned, holds an unchanged position as it may be imported free after going through a denaturing process. Its use, however, in the edible trades undoubtedly will be curtailed. In the first quarter of this year 3,985,123 lb. was refined in this country and used in the edible trades.

Soya bean oil under an import of 5c. per pound will be handicapped so severely that very low prices will have to prevail in foreign markets before it can be considered on an import basis. In the acid group a greater advantage consumption of crude soya bean oil was 6,400,730 lb. and of refined 1,094,027 lb.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**113.24**
Last month	113.31
May, 1928	113.20
May, 1927	112.95

Lower price levels ruled for some of the metal salts but in general the market was featured by an unchanged price position. An exception was found in the case of denatured alcohol which was marked up because of the firmer position of raw materials.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**117.61**
Last month	123.14
May, 1928	128.38
May, 1927	129.97

Crude cottonseed oil was lower than in the preceding month and, with the exception of linseed and china wood oils, an easier tone permeated the general market for oils and fats. Tallow was appreciably lower and aided in lowering the weighted index number.

CURRENT PRICES *in the* NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to May 14.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.14 -$0.15	$0.14 -$0.15	$0.13 -$0.14
Acid, acetic, 28%, bbl.	cwt.	3.88 - 4.03	3.88 - 4.03	3.38 - 3.63
Boric, bbl.	lb.	.06½ - .07	.06½ - .07	.08½ - .08½
Citric, kegs	lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl.	lb.	.11 - .12	.11 - .12	.11 - .12
Gallic, tech., bbl.	lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl.	lb.	.11½ - .12	.11½ - .12	.13 - .13½
22%, tech., light, bbl.	lb.	.05½ - .06	.05½ - .06	.06 - .07
Muriatic, 18°, tanks	cwt.	.85 - .90	.85 - .90	.85 - .90
Nitric, 36°, carboys	lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl.	lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys.	lb.	.08½ - .09	.08½ - .09	.08½ - .09
Sulphuric, 60°, tanks	ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl.	lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl.	lb.	.38 - .39	.38 - .39	.38 - .39
Tungstic, bbl.	lb.	1.00 - 1.20	1.00 - 1.20	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl.	gal.	2.68½ - 2.71	2.68½ - 2.71	2.68½ - 2.71
Alcohol, Butyl, dr.	lb.	.17½ - .18	.17½ - .18	.18¼ - .19
Denatured, 190 proof				
No. 1 special dr.	gal.	.49 -	.48	.44 - .....
No. 5, 188 proof, dr.	gal.	.49 -	.48	.43 - .....
Alum, ammonia, lump, bbl.	lb.	.03½ - .04	.03½ - .04	.03½ - .04
Chrome, bbl.	lb.	.05¼ - .05½	.05¼ - .05½	.05½ - .06
Potash, lump, bbl.	lb.	.03 - .03½	.03 - .03½	.02½ - .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg.	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Aqua ammonia, 26°, drums	lb.	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl.	lb.	.14 -	.14 -	.13½ - .....
Ammonium carbonate, powd. tech., casks	lb.	.12 - .13	.12 - .13	.10½ - .14
Sulphate, wks.	cwt.	2.30 -	2.35 -	2.60 - .....
Amylacetate tech., drums	gal.	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Antimony Oxide, bbl.	lb.	.10½ - .10¾	.10½ - .10¾	.13½ - .15
Arsenic, white, powd., bbl.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs	lb.	.09 - .10	.09 - .10	.09½ - .10
Barium carbonate, bbl.	ton	58.00 -60.00	58.00 -60.00	57.50 -60.00
Chloride, bbl.	ton	65.00 -67.00	65.00 -67.00	55.00 -58.00
Nitrate, cask	lb.	.08½ - .09	.07½ - .08	.08 - .08½
Blanc fixe, dry, bbl.	lb.	.03½ - .04	.03½ - .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl.	lb.	.02½ - .03	.02½ - .03	.04 - .04½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	cwt.	4.50 -	4.50 -	3.50 - .....
Arsenate, dr.	lb.	.06½ - .07	.06½ - .07	.06½ - .07
Carbide drums	lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks.	ton	20.00 -	20.00 -	20.00 - .....
Phosphate, bbl.	lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums	lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums	lb.	.06½ - .07	.06½ - .07	.06½ - .07
Chlorine, liquid, tanks, wks.	lb.	.03 - .03½	.03 - .03½	.03½ - .04½
Cylinders	lb.	.05 - .08	.05 - .08	.05½ - .08
Cobalt oxide, cans	lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	15.00 -16.00	15.00- 16.00	16.00 -17.00
Copper carbonate, bbl.	lb.	.19 - .21	.19 - .21	.18½ - .19
Cyanide, tech., bbl.	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	6.00 - 6.10	6.50 - 6.60	5.05 - 5.15
Cream of tartar, bbl.	lb.	.27½ - .28	.27½ - .28	.25½ - .27
Diethylene glycol, dr.	lb.	.10 - .15	.10 - .15	.10 - .15
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums	gal.	1.03 -	1.03 -	.83 - .....
Formaldehyde, 40%, bbl.	lb.	.09½ .10	.09½ - .10	.08½ - .09
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums	gal.	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr.	gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Glaubers salt, bags	cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, e.p., drums, extra	lb.	.14½ - .15	.15½ - .16	.15 -½ .16½
Lead:				
White, basic carbonate, dry, casks	lb.	.09	.09 -	.08½ - .....
White, basic sulphate, sck.	lb.	.08½	.08½ -	.07½ - .....
Red, dry, sck.	lb.	.10½ -	.10½ -	.09½ - .....
Lead acetate, white crys., bbl.	lb.	.14 - .14½	.14 - .14½	.13 - .13½
Lead arsenate, powd., bbl.	lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk	ton	8.50 -	8.50 -	8.50 - .....
Litharge, pwd., csk.	lb.	.09½ -	.09½ -	.08½ - .....
Lithopone, bags	lb.	.05¼ - .06	.05¼ - .06	.05½ - .06½
Magnesium carb., tech., bags	lb.	.06 - .06½	.06 - .06½	.07½ - .08
Methanol, 95%, dr.	gal.	.55 -	.55 -	.43 - .....
97%, dr.	gal.	.55 -	.55 -	.45 - .....
Nickel salt, double, bbl.	lb.	.13 - .13½	.13 - .13½	.10 - .10
Single, bbl.	lb.	.13 - .13½	.13 - .13½	.10½ - .11½
Orange mineral, csk.	lb.	$0.12½ -	$0.12½ -	$0.11½ - .....
Phosphorus, red, cases	lb.	.55 - .57	.55 - .57	.62 - .65
Yellow, cases	lb.	.32 - .33	.32 - .34	.32 - .33
Potassium bichromate, casks	lb.	.08½ - .08¾	.08½ - .08¾	.08½ - .08¾
Carbonate, 80-85%, calc., csk.	lb	.05½ - .06	.05½ - .06	.05½ - .06
Chlorate, powd.	lb.	.07½ - .08½	.07½ - .08½	.08¼ - .09
Cyanide, cs.	lb.	.52 - .55	.52 - .55	.55 - .57
First sorts, csk.	lb.	.08½ - .09	.08½ - .09	.08½ - .09
Hydroxide(c'stic potash) dr.	lb.	.07½ - .07¾	.07½ - .07¾	.07½ - .07¾
Muriate, 80% bgs.	ton	36.75 -	36.40 -	36.40 - .....
Nitrate, bbl.	lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums	lb.	.16 - .16½	.16 - .16½	.15 - .16
Prussiate, yellow, casks	lb.	.19 - .19½	.19 - .19½	.18 - .19
Sal ammoniac, white, casks	lb.	.046- .05	.046- .05	.047- .05
Salsoda, bbl.	cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk	ton	16.00 -18.00	15.00 -17.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.32 -	1.32 -	1.32 - .....
Dense, bags	cwt.	1.35 -	1.35 -	1.35 - .....
Soda, caustic, 76%, solid, drums, contract	cwt.	2.80 - 3.00	2.80 - 3.00	3.00 - 3.10
Acetate, works, bbl.	lb.	.05 - .05½	.05 - .05½	.05½ - .06
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks	lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk	ton	12.00 -15.00	12.00 -15.00	3.00 - 3.50
Bisulphite, bbl.	lb.	.03½ - .03¾	.03½ - .03¾	.03¾ - .04
Chlorate, kegs	lb.	.07 - .07½	.06½ - .07	.06½ - .06½
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl.	lb.	.08½ - .09½	.08½ - .09½	.08½ - .09
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Nitrate, bags	cwt.	2.15 -	2.15 -	2.35 - .....
Nitrite, casks	lb.	.07½ - .08	.07½ - .08	.07½ - .08
Phosphate, dibasic, bbl.	lb.	.03½ - .03¾	.03 - .03¼	.03¼ - .03¾
Prussiate, yel. drums	lb.	.11½ - .12	.11½ - .12	.11½ - .12
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.02½ - .03¾	.02½ - .03	.03¼ - .04
Sulphite, crys., bbl.	lb.	.02½ - .03	.02½ - .03	.02¼ - .03
Strontium nitrate, bbl.	lb.	.09 - .09½	.09 - .09½	.09 - .09½
Sulphur, crude at mine, bulk	ton	18.00 -	18.00 -	18.00 - .....
Chloride, dr.	lb.	.04½ - .05	.04 - .05	.04 - .05
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.09 - .10
Flour, bag	cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl.	lb.	.14½ -	.15 -	.15½ - .....
Oxide, bbl.	lb.	.53 -	.53 -	.56 - .....
Crystals, bbl.	lb.	.35 -	.36 -	.38½ - .....
Zinc chloride, gran., bbl.	lb.	.06½ - .06½	.06½ - .06½	.06½ - .06½
Carbonate, bbl.	lb.	.10½ - .11	.10 - .10½	.10 - .11
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.08½ - .09	.08½ - .09	.09 - .10
Zinc oxide, lead free, bag.	lb.	.06½ -	.06½ -	.06½ - .....
5% lead sulphate, bags	lb.	.06½ -	.06½ -	.06½ - .....
Sulphate, bbl.	cwt	3.50 - 3.75	2.75 - 3.00	2.75 - 3.00

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.13½-$0.14	$0.13½-$0.14	$0.13½-$0.14
Chinawood oil, bbl.	lb.	.15 -	.14½ -	.14½ - .....
Coconut oil, Ceylon, tanks, N. Y.	lb.	.07½ -	.08 -	.08½ - .....
Corn oil crude, tanks, (f.o.b. mill)	lb.	.08½ -	.08½ -	.09½ - .....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.08 -	.08½ -	.08½ - .....
Linseed oil, raw, car lots, bbl.	lb.	.101 -	.098 -	.102 - .....
Palm, Lagos, casks	lb.	.08½ -	.09 -	.07½ - .....
Niger, casks	lb.	.08 -	.08½ -	.07½ - .....
Palm Kernel, bbl.	lb.	.08½ -	.08½ -	.09½ - .....
Peanut oil, crude, tanks (mill)	lb.	.08½ -	.10 -	.09½ - .....
Rapeseed oil, refined, bbl.	gal.	.82 - .83	.86 - .87	.85 - .86
Soya bean tank (f.o.b. Coast)	lb.	.09½ -	.09½ -	.09½ - .....
Sulphur (olive foots), bbl.	lb.	.10½ -	.10½ -	.09½ - .....
Cod, Newfoundland, bbl.	gal.	.65 - .67	.65 - .67	.66 - .67
Menhaden, light pressed, bbl	gal.	.70 - .72	.70 - .72	.60 - .66
Crude, tanks (f.o.b. factory)	gal.	.48 -	.48	.40 - .....
Whale, crude, tanks	gal.	.80 -	.80	.....
Grease, yellow, loose	lb.	.07 -	.07½ -	.06½ - .....
Oleo stearine	lb.	.09½ -	.11 -	.11½ - .....
Red oil, distilled, d.p. bbl.	lb.	.09½ - .10	.09½ - .10	.09½ - .09¾
Tallow, extra, loose	lb.	.07½ -	.08½ -	.08½ - .....

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl.	lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl.	lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra	lb.	.14½ - .15	.14½ - .15	.15 - .16
Aniline salts, bbl.	lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

		Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr.	lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl.	lb.	.67 - .70	.67 - .70	.70 - .72
Benzoic acid, U.S.P., kgs.	lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech, dr.	lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works	gal.	.23 - .25	.23 - .25	.21 - .22
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.	lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks.	gal.	.70 - .73	.73 - .75	.73 - .75
Diethylaniline, dr.	lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl.	lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoluen, bbl.	lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr.	gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl.	lb.	.42 - .43	.42 - .43	.45 - .47
H-acid, bbl.	lb.	.60 - .63	.60 - .63	.63 - .65
Naphthalene, flake, bbl.	lb.	.04½ - .05	.04½ - .05	.05 - .06
Nitrobenzene, dr.	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl.	lb.	.55 - .56	.55 - .56	.52 - .53
Para-nitrotoluine, bbl.	lb.	.29 - .31	.29 - .31	.28 - .32
Phenol, U.S.P., drums	lb.	.13 - .14	.13½ - .14	.17 - .18
Picric acid, bbl.	lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr.	lb.	1.75 - 1.90	1.75 - 1.90	1.90 - .....
R-salt, bbl.	lb.	.44 - .45	.44 - .45	.47 - .50
Resorcinal, tech, kegs.	lb.	1.30 - 1.35	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech., bbl.	lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w.,tanks	gal.	.30 - .35	.30 -	.35 - .....
Toidine, bbl.	lb.	.86 - .90	.86 - .90	.95 - .96
Toluene, tanks, works	gal.	.45 -	.45 -	.35 - .....
Xylene, com., tanks	gal.	.30 - .40	.30 - .35	.36 - .40

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl.	lb.	.16 - .16½	.16 - .16½	.16 - .18
China clay, dom.,f.o.b. mine	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.08 - .13	.08 - .13	.06½ - .07
Prussian blue, bbl	lb.	.35 - .36	.32 - .33	.31 - .32
Ultramine blue, bbl.	lb.	.26 - .32	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.30 - .32	.30 - .32	.27 - .30
Carmine red, tins	lb.	6.00 - 6.50	6.00 - 6.50	5.50 - 5.75
Para toner	lb.	.70 - .75	.70 - .75	.70 - .80
Vermilion, English, bbl.	lb.	1.85 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl.	lb.	.17 - .17½	.16 - .16½	.17 - .18
Feldspar, No. 1 (f.o.b. N. C.)	ton	6.50 - 7.50	5.75 - 7.00	5.75 - 7.00
Graphite, Ceylon, lump, bbl	lb.	.07½ - .08½	.08 - .08½	.08 - .09
Gum copal, Congo, bags	lb.	.07½ - .08	.07½ - .08	.07½ - .08
Manila, bags	lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases	lb.	.24 - .25	.24 - .25	.25 - .25
Kauri, No. 1 cases	lb.	.48 - .53	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	40.00 -	40.00 -	44.00 - .....
Pumice stone, lump, bbl.	lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	bbl.	8.45 -	8.45 -	9.00 - .....
Turpentine	gal.	.54 -	.53 -	1.53½ - .....
Shellac, orange, fine, bags	lb.	.61 -	.61 -	.51 - .52
Bleached, bonedry, bags	lb.	.56 - .58	.58 - .60	.54 - .56
T. N. bags	lb.	.42 - .43	.44 - .45	.44 - .45
Soapstone (f.o.b. Vt.), bags	ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.)	ton	9.50 -	9.50 -	10.50 - .....
300 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.)	ton	13.75 -	13.75 -	13.75 -

		Current Price	Last Month	Last Year
Wax, Bayberry, bbl.	lb.	$0.28 -$0.32	$0.28 -$0.31	$0.24 -$0.26
Beeswax, ref., light	lb.	.41 - .42	.41 - .42	.43 - .45
Candelilla, bags	lb.	.22 - .23	.22 - .24	.24 - .27
Carnauba, No. 1, bags	lb.	.36 - .38	.36 - .38	.54 - .55
Paraffine, crude 105-110 m.p.	lb	04½ - .05	04½ - .05	04½ - .05

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-	$200.00-	$200.00- .....
Ferromanganese, 78-82%	ton	105.00-	105.00-	100.00- .....
Spiegeleisen, 19-21%	ton	33.00-	33.00-	31.00-32.00
Ferrosilicon, 14-17%	ton	45.00-	45.00-	33.00-38.00
Ferrotungsten, 70-80%	lb.	1.25	1.25-	.90- .95
Ferro-uranium, 35-50%	lb.	4.50-	4.50-	4.50- .....
Ferrovanadium, 30-40%	lb.	3.15- 3.75	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.18 -	$0.19 -	$0.14½ - .....
Aluminum, 96-99%	lb.	24 - .26	.24 - .26	.24 - .25
Antimony, Chin. and Jap.	lb.	.09½	.09½	.10 - .....
Nickel, 99%	lb.	35 -	.35 -	.35 - .....
Monel metal, blocks	lb.	28 -	.28 - .28	.32 - .33
Tin, 5-ton lots, Straits	lb.	44½ -	.45½ -	.51½ - .....
Lead, New York, spot	lb.	7 00 -	7.15 -	6 10 - .....
Zinc, New York, spot	lb.	6 90 -	7.00 -	6.05 - .....
Silver, commercial	oz.	54½ -	55½ -	57½ - .....
Cadmium	lb.	.85 - .95	.85 - .95	60 - .....
Bismuth, ton lots	lb.	1.70 -	1.70 -	1 85 - 2.10
Cobalt	lb.	2.10 - 2.50	2.10 - 2.50	2 50 - .....
Magnesium, ingots, 99%	lb.	.85 - 1.10	.85 - 1.10	.75 - .80
Platinum, ref	oz.	70 00- 72.50	70 00- 72.50	85 00
Palladium, ref.	oz.	38 00- 40.00	38 00- 40.00	50 00 52.00
Mercury, flask	75 lb.	123 00-	124.00-	124 50- .....
Tungsten powder	lb.	1 20- 1 35	1.20- 1.35	1.05- .....

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	22.00- 25.00	22.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens	ton	2.85- 3.00	2.85- 3.00	2.85- 3.00
Fluorspar, gravel, f.o.b. Ill.	ton	18.00- 20.00	18.00- 20.00	14.50- .....
Ilmenite, 52% TiO_2, Va.	lb.	.00¾ - .00¾	.00¾- .00¾	.00¾- .....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.34 - .37	.34 - .37	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.48 - .50	.48 - .50	.48- .50
Monasite, 6% of ThO_2	ton	130.00-	130.00-	120.00- .....
Pyrites, Span. fines, c.i.f.	unit	.13 -	.13 -	.13½ - .....
Rutile, 94-96% TiO_2	lb.	.11 - .13	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO_3 and over	unit	15.00	15 00 -	11.25 -11.50
Vanadium ore, per lb. V_2O_5	lb.	.28	.28 -	.25 - .28
Zircon, 99%	lb.	03 -	03 -	03 - .....

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Aluminum Factory—Aluminum Co. of America, Garwood, N. J., is receiving bids for a two 1 story, 60 x 120 and 25 x 150 ft. additions to aluminum factory at Garwood. Estimated cost $40,000. Private plans.

Asphalt Plant—City of Freeport, Tex., have acquired asphalt plant of Freeport Sulphur Co. and plans extensions and improvements to include machinery and equipment for the manufacture of asphalt. R. J. Wilkinson, 3701 Delgado Ave., New Orleans, La., is engineer.

Asphalt Plant — Huffman Construction Co., Stop 13, Lakeshore Rd., New Toronto, Ont., plans the construction of an asphalt plant and warehouse on Roselawn Ave. Estimated cost $50,000. Work will be done by owners' forces.

Brass and Copper Plant—Chase Brass & Copper Co., F. S. Chase, Pres., 236 Grand St., Waterbury, Conn., awarded contract for a 1 story, 100 x 150 ft. brass and copper plant to Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $3,000,000.

Briquetting Plant—People's Fuel Co., J. F. Shelton, Mgr., Bellingham, Wash., plans the construction of a coal briquetting plant. Estimated cost $25,000.

Bronze Powder Mill and Laboratory — Aluminum Co. of America, Oliver Bldg., Pittsburgh, Pa., will build a 1 story bronze powder mill at Alcoa, Tenn. Work will be done by separate contracts, also plans a laboratory at New Kensington, Pa. Estimated cost $1,000,000 and $500,000 respectively.

Burner and Filter Buildings—Gulf Refining Co., Sydenham and Locust Sts., Philadelphia, Pa., will soon award contract for the construction of a 40 x 114 ft. burner building and 66 x 98 ft. filter buildings at Girard Point. E. B. Lee, Chamber of Commerce Bldg., Pittsburgh, is architect.

Cable Tram and Concentration Mill—Shenandoah-Dives Syndicate, J. A. McKay, Mgr., Silverton, Colo., plans the construction of a concentration mill of oil flotation type, 300 ton daily capacity near Silverton, also cable tram to run from Mayflower mines to mill.

Carbide & Carbon Plant—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a plant at Wichita, Kan. Estimated cost $125,000. Private plans.

Carbon Gas Plant—Liquid Carbonic Co., McDajiel and Stephens Sts. S. W., Atlanta, Ga., awarded contract for a 1 story, 72 x 80 ft. addition to plant to Flager Co., 304 Red Rock Bldg., Atlanta. Estimated cost $25,000.

Carbonic Gas Plant—Natural Carbonic Gas Co., McClellan St., Newark, N. J., awarded contract for a 1 story factory to Enstue Bros., 111 Academy St., Newark. Estimated cost $40,000.

Cement Plant and Quarry — Port Stockton Cement Co., Stockton, Calif., is having plans prepared for the construction of a cement plant at Stockton, 1,000,000 bbl. capacity, also quarry at Columbia. Estimated cost $2,250,000 and $700,000 respectively. W. C. Stevenson, 15 Cerriots St., San Francisco, is engineer.

Ceramic and Brick Manufacturing Plant—R. A. Hay, Box 1330 San Antonio, Tex., plans the construction of a ceramic and brick manufacturing plant for development of a clay deposit near San Antonio. Private plans. Grinding and manufacturing machinery will be required.

Chemical Factory — Canadian Industrial Alcohol Co., Corbyville, Ont., is having plans prepared for a 5 or 6 story chemical factory at Lindsay, Ont. Estimated cost $200,000. Thomson & Johnson, Front St., Belleville, are architects.

Chemical Factory—McGean Chemical Co., 1822 B. F. Keith Bldg., Cleveland, O., is receiving bids for a group of buildings for chemical factory at Clark Ave. and B. & O. R.R. tracks. Estimated cost $150,000. Christian, Schwarzenberg & Gaede Co., 1836 Euclid Ave., Cleveland, O., are architects.

Chemical Factory—Naugatuck Chemical Co., Elm St., Naugatuck, Conn., awarded contract for a 3 story, 60 x 144 ft. addition to chemical factory to Tracy Bros. Co., 52 Benedict St., Waterbury. Estimated cost $75,000.

Chemical Factory—Plough Chemical Co., A. Plough, 121 South Second St., Memphis, Tenn., will soon award contract for the construction of a 5 story chemical factory. Estimated cost $1,000,000. Hanker & Cairns, 123 South Court St., Memphis, are architects. Jackson & Moreland, 31 St. James Ave., Boston, Mass., are engineers.

Chemical Factory—Selden Co., 339 2nd Ave., Pittsburgh, Pa., awarded contract for a 1 story, 80 x 150 ft. factory at Bridgeville, to Austin Co., Union Trust Bldg., Pittsburgh. Estimated cost $50,000.

Chemical Factory—Zemmer Co., Sennott St., Pittsburgh, Pa., awarded contract for a 2 story, 60 x 100 ft. addition to chemical factory to

L. L. Duffie, 307 Maple Ave., Pittsburgh. Estimated cost $40,000.

Compressed Gas Plant—Linde Air Products Co., 530 South Howell St., Davenport, Ia., awarded contract for a 60 x 100 ft. compressed gas plant to John Soller Construction Co., Masonic Temple, Davenport. Estimated cost $30,100.

Copper Plant Addition — Raritan Copper Works, Elm St., Perth Amboy, N. J., will build three 1 story additions to copper plant. Estimated cost $55,000. Private plans. Work will be done by separate contracts.

Dry Ice Plant—Liquid Carbonic Corp., 3100 Kedzie Ave., Chicago, Ill., awarded contract for a 3 story plant for the manufacture of carbonic gas, dry ice, etc., at St. Louis, Mo., to H. K. Ferguson Co., Hanna Bldg., Cleveland, O., also let contract for the design and construction of a 2 story, 125 x 150 ft. dry ice plant at Denver, Colo. to Austin Co., 510 North Dearborn St., Chicago, Ill. Estimated cost $150,000.

Galvanizing Plant — American Galvanizing Co., 83 Florence St., Revere, Mass., will build a 1 story, 50 x 100 ft. plant at Everett and Beach Sts. Private plans. Work will be done by separate contracts.

Gas Plant—British Columbia Electric Ry. Ltd, 1016 Langley St., Victoria, B. C., awarded contract for a gas plant, 500,000 ft. daily capacity to include carburated water gas machine with boilers, pumps, washers, etc. to Humphrey & Glasgow Engineering Co., Leeds, England. Estimated cost $40,000.

Gas Plants—Cape Cod & Buzzards Bay Gas Co., Buzzards Bay, Mass., c/o P. P. Crofts and T. R. Robinson, 1 State St., Boston, plans the construction of two gas plant at Bourne. Estimated total cost $50,000. Architect not selected.

Gas and Coke Plants—Windsor Gas Co., G. D. Wickett, Gen. Mgr., 129 Chatham St. W., Windsor, Ont., awarded contract for the construction of a gas plant at Windsor to General Oil & Gas Co., 24 Broad St., New York, N. Y., also has under consideration a coke plant at La Salle.

Gas Plant Improvements—Pacific Gas & Electric Co., 445 Sutter St., San Francisco, Calif., plans additions and improvements to plant and system including 500,000 cu.ft. gas tank, 97 ft. in diameter and 96 ft. high at Marysville. Estimated cost $100,000. Private plans.

Glass Plant—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., will soon award contract for the construction of a plant in. cluding four 40 x 300 ft. cutting sheds, 200 x 300 ft. warehouse and two 110 x 177 ft. tank sheds, etc. at Henryetta, Okla.; also plans a 400 x 2,600 ft. glass plant at Santa Ana, Calif. Estimated cost $2,000,000 and $4,000,000 respectively.

Graphite Plant — Annandale Graphite Co., Annandale, N. J., plans the construction of a 2 story addition to plant. Estimated cost $40,000. Architect not announced.

Kid Plant Addition—Benz Kid Co., 215 Market St., Lynn, Mass., plans the construction of a 4 story addition to factory at Boston and Marion Sts. Estimated cost $50,000. Architect not selected.

Kilns, Etc.—Dexter Lumber & Flooring Co., Scottdale, Pa., is having plans prepared for the construction of dry kilns and boiler plant to include one 300 hp. boiler. Estimated cost $40,000. Private plans.

Laboratory—Gulf Refining Co., Frick Bldg. Pittsburgh, Pa., awarded contract for a 3 story, 52 x 103 ft. laboratory at Craft and Emily Sts. to Mellon Stuart Co., Oliver Bldg. Estimated cost $200,000.

Laboratory (Chemical) — Bd. of Education, Township Hall, Millburn, N. J., is having plans prepared for addition to high school including chemical laboratory, etc. at Old Short Hills Rd. Estimated cost $650,000. Guilbert & Betelle, 20 Branford Pl., Newark, are architects.

Laboratory (Chemical)—Henry Bower Chemical Mfg. Co., 29th St. and Grays Ferry Rd., Philadelphia, Pa., awarded contract for a 2 story, 28 x 42 ft. laboratory to P. Haibach Co., 1261 North 26th St., Philadelphia.

Laboratory (Chemical)—Dearborn Chemical Co., 1029 West 35th St., Chicago, Ill., awarded contract for masonry, etc., for a 39 x 90 ft. chemical laboratory. Estimated cost $45,000.

Laboratory (Chemistry) — Alabama Polytechnic Institute, B. Knapp, Pres., Auburn, Ala., awarded contract for a 88 x 174 ft. chemistry laboratory to Frost Construction Co., 607 Marino St., Tampa, Fla. Estimated cost $224,000.

Laboratory (Electrical Engineering)—University of Illinois, Urbana, Ill., will soon award contract for the construction of an electrical engineering laboratory. J. M. White, 256 Administration Bldg., c/o University of Illinois, Urbana, is architect.

Laboratory, Etc.—J. F. Class, 219 West First St., Dayton, O., plans the construction of a 60 x 100 ft. laboratory and 125 x 250 ft. factory on Findlay St. Estimated cost $100,000.

Laboratories—Atchison, Topeka & Santa Fe Hospital Assn., c/o F. Biddenger, Topeka, Kan., is having preliminary plans prepared for a 5 story hospital including laboratories, etc. G. A. Carlander, 1016 Fisk Medical & Professional Bldg., Amarillo, Tex., is architect.

Laboratories—Browne & Nichols, G. Nichols, 20 Garden St., Cambridge, Mass., is having plans prepared for a 1 and 2 story school including laboratories, etc. Estimated cost $150,000. Coolidge & Carlson, 89 State St., Boston, are architects.

Laboratories—School Board, Welland, Ont., awarded contract for a 3 story, 70 x 160 ft. vocational school including laboratories, etc. on Main St. to G. C. Scott, 262 North Main St., Weiland. Estimated cost $200,000.

Laboratories (Chemistry and Pharmacy)—Bd. of Trustees, Purdue University, R. B. Stewart, West Lafayette, Ind., Comptroller, will soon award contract for the construction of a group of buildings, including chemistry and pharmacy laboratories, etc. W. Scholer, 301 Painters' and Decorators' Bldg., Lafayette, is architect.

Lacquer Plant—C. N. Fries Co., 3625 South Ashland Ave., Chicago, Ill., manufacturers of linoleum paste, lacquers, etc., awarded contract for the construction of a 1 story plant at 66th Pl. and South Naragansett Ave. to F. C. Foltz & Co., 6455 South Central Ave., Chicago.

Lacquer Factory—E. Ingraham Co., 392 North Main St., Bristol Conn., awarded contract for a 5 story, 50 x 80 ft. lacquer factory to Torrington Building Co., 182 Church St., Torrington. Estimated cost $70,000.

Leather Factory—Hugh Carson Co., Ltd., Albert St., Ottawa, Ont., manufacturers of leather goods, awarded contract for addition to factory to A. Garvock, Sparks Regent Bldg., Ottawa. Estimated cost $50,000.

Linoleum Factory—W. Volker Co., 631 Howard St., San Francisco, Calif., is having plans prepared for a 5 story factory for the manufacture of linoleum, window shades, etc. Estimated cost $150,000. G. Kelham, 315 Montgomery St., San Francisco, is architect.

Linseed Oil Plant—Dominion Linseed Co., Ltd., W. Haston, Mgr., Owen Sound Ont., plans the construction of a plant. Estimated cost $75,000.

Lye Kettle House—Lever Bros. Co., 164 Broadway, Cambridge, Mass., awarded contract for the construction of a lye kettle house to C. H. Cunningham & Sons Co., 23 Central St., Lynn, Mass.

Neolight Plant—Neolight Laboratories, Inc., 5515 South Vermont St., Los Angeles, Calif., plans the construction of a plant for the manufacture of neon signs at El Paso, Tex., 200 lin.ft. neon tubing daily capacity. Estimated cost $100,000. Private plans.

Oil Plant—Beacon Oil Co., South Leonard St., Waterbury, Conn., will build three buildings for oil plant, 30 x 60, 30 x 30 and 10 x 20 ft. to include five 2,000 gal. oil storage tanks. Estimated cost $42,000. Work will be done by owners forces.

Paint Factory—General Paint Corp., 160 Fremont St., San Francisco, Calif., plans the construction of a factory at Los Angeles. Estimated cost $150,000.

Paper Manufacturing Plant—Hollingsworth & Vose Co., 333 Washington St., Boston, Mass., are having sketches made for a 2 story paper manufacturing plant at Walpole, Mass. C. Eldrid, Walpole, is engineer.

Paper Plant—Chemical Paper Mfg. Co., Jackson St., Holyoke, Mass., is having plans prepared for two buildings 2 story, 55 x 195 ft. and 3 story, 35 x 75 ft. for paper plant. Estimated cost $300,000. Private plans.

Paper Plant—G. H. Sweetman, 645 Atlantic Ave., Boston, Mass., awarded contract for a 1 story, 50 x 150 ft. paper manufacturing plant on Portland St. Cambridge, to Eldon Smith, 80 Ashford St., Allston. Estimated cost $40,000.

Pigment Plant—Magnetic Pigment Co., Cass and Canal Sts., Trenton, N. J., awarded contract for the construction of a 4 story factory on Wolverton St. to N. A. Bugbee, 206 East Hanover St., Trenton. Estimated cost $77,500.

Pottery Plant Addition — Shenango Pottery Co., New Castle, Pa., is receiving bids for the construction of a 1 story, 160 x 400 ft. addition to pottery plant including kiln shed, two new tunnel kilns, etc. Estimated cost $100,000 to $150,000.

Powder Plant—Alexander Merchant, 52 Patterson St., New Brunswick, N. J., Archt., is receiving bids for a 2 story powder plant at Sayreville, for Hercules Powder Co., Delaware Trust Bldg., Wilmington, Del. Estimated cost $40,000.

Process Plant and Laboratory—Raybestos Co., A. V. Bodine, Railroad Ave., Bridgeport, Conn., awarded contract for the construction of a 2 story, 50 x 100 process plant and laboratory at Stratford, Conn., to W. J. Shaugnessy, Inc., 199 Fairfield Ave., Bridgeport. Estimated cost $40,000.

Pulp and Timber Plant—Puget Sound Pulp & Timber Co., Sedro Woolley, Wash., plans to reopen Clear Lake mill and expend $200,000 for extensions and improvements, to include installation of new equipment.

Radio Tube Plant Addition—Sylvania Products Co., Emporium, Pa., awarded contract for a 2 story, 80 x 240 ft. addition to radio tube plant to Rust Engineering Co., American State Bank Bldg., Pittsburgh. Estimated cost $150,000.

Refinery (Oil)—Wilcox Oil & Gas Co., Pampa, Tex., will build an oil refinery, 2,000 bbls. daily capacity. Estimated cost $150,000. Private plans. Work will be done by day labor.

Rayon Plant—J. McDowell & Associates, 917 City National Bank Bldg., San Antonio, Tex., plan the construction of a plant for the manufacture of rayon, silk cotton, wool and mohair to include, 200 x 396 ft. weaving mill with 12,610 spindles and 232 looms, 85 x 200 ft. spinning silk mill, wool scouring plant, etc., at New Braunfels. Estimated cost $1,000,000.

Refinery (Oil)—Golden West Oil Co., Del Rio, Tex., is having preliminary plans prepared for the construction of an oil refinery near Hondo or Devine, Tex., also plans main pipe line from Ina field to plant. Private plans.

Refinery (Oil)—Humble Oil & Refining Co., Humble Bldg., Houston, Tex., have acquired a 20 acre site in Neches oil field near Palestine and plans the construction of an oil refinery. Estimated cost $300,000. Private plans.

Refinery (Oil)—Port Everglades Refining Co., Fort Lauderdale, Fla., c/o C. K. MacFadden, 90 West St., New York, N. Y., awarded contract for an oil refinery, 5,000 bbl. minimum capacity at Fort Lauderdale, Fla. to Fisher-Williams Corp., 103 Park Ave., New York, N. Y.

Refinery (Oil)—Tidal Refining Co., 602 South Cheyenne St., Tulsa, Okla., plans the construction of an oil refinery to include tank and equipment at Houston, Tex. Estimated cost $3,000,000 to $4,000,000.

Rotary Furnaces, etc.—Oregon Mercury Co., Roseberg, Ore., will reopen Burna Vista mercury mines, nine miles northeast of Tiller; new rotary furnace, engines, pumps, hoists, track and cars, etc., will be installed.

Rayon Factory—American Glanzstoff Co., Elizabethtown, Tenn., awarded contract for the construction of second unit of rayon factory to Hughes-Foulkrod Co., Schoff Bldg., Philadelphia, Pa. Estimated cost $6,000,000.

Rubber Factory—Goodyear Tire & Rubber Co., 1144 East Market St., Akron, O., awarded contract for the construction of a 3 story, 150 x 750 ft. factory, 4 story, 120 x 250 ft. warehouse and 1 story, 150 x 250 ft. weave shed, etc. at Rockmart, Ga. to A. K. Adams & Co., 542 Plum St. W., Atlanta, Ga. Estimated cost $750,000.

Rubber Factory—Hodgman Rubber Co., Herbert St., Framingham, Mass., awarded contract for a 1 story, 60 x 100 ft. factory to J. H. Howard, 3450 Union Ave., Framingham.

Salt Plant Addition—Alviso Salt Co., Russ Bldg., San Francisco, Calif., is having plans prepared for addition to plant to include loading and unloading bunkers, barges, shovels, etc. at Alviso. Estimated cost $30,000. Private plans.

Salt Plant—Morton Salt Co., 208 West Washington St., Chicago, Ill., awarded contract for a 2 story, 403 x 531 ft. warehouse in connection with salt plant at Elston Ave. and Blackhawk St. to J. B. French & Co., 30 North Michigan Ave., Chicago, Ill.

Smelting Plant and Foundry—J. & S. Paynier, 835 Humboldt St., Brooklyn, N. Y., plans the construction of a 2 story, 75 x 180 ft. smelting plant at foundry at Borden Ave. and Haywood St., Long Island City. Estimated cost $40,000. J. M. Klein, 65 Court St., Brooklyn, is architect.

Soap Factory—Proctor & Gamble Co., Port Ivory, N. Y., awarded contract for a 3 story, 100 x 112 ft. addition to Camay soap building at Port Ivory to H. K. Ferguson Co., Hanna Bldg., Cleveland, O.; awarded contract for a factory to include 60 x 90 ft. process building, 60 x 80 ft. warehouse and alterations to glycerine house, etc. at Hamilton, Ont. to W. H. Yates Co., 17 Main St., E. Hamilton; also takes bids until June 3 for a 3 story, 96 x 306 ft. factory at Baltimore, Md. Estimated cost, $100,000, $250,000 and $1,000,000 respectively.

Tile Factory—Cambridge Tile Mfg. Co., 10th and Woodburn Sts., Covington, Ky., awarded contract for a 1 story tile factory on Forest St., Hartwell, O., to Roos-Meyer-Hecht Co., Stanton St., Cincinnati, O. Estimated cost $1,000,000.

Tile Factory—Duraflex Co., R. Bolgiano, Pres., 11 East Pleasant St., Baltimore, Md., plans addition to tile factory.

Tube Mill and Storage Building—Bridgeport Brass Co., R. E. Day, Gen. Mgr., Bridgeport, Conn., awarded contract for a 1 story, 40 x 120 ft. tube mill and storage building to Hewlett Co., 884 Main St., Bridgeport. Estimated cost $100,000.

Washing Products Plant — Moorewood Products Co., Ltd., Calgary, Alta., plans the construction of a plant for the manufacture of kalsomine, washing compounds, plaster of paris, etc. Estimated cost $100,000.

Wool Products Plant—Banner Rock Products Co. Div. of Johns-Manville Corp., Madison Ave. and 41st St., New York, N. Y., had plans prepared for the construction of a 1 and 3 story, 54 x 192 and 120 x 160 ft. factory buildings for the manufacture of rock wool products at Alexandria, Ind. Estimated cost $110,000.

Yeast Plant — Fleischmann Yeast Co. of Canada, St. Urbain St., Montreal, Que., plans the construction of an 80 x 80 ft. plant to include cutting and wrapping building, engine house, power house and pumping station. Estimated cost $500,000. Laurentide Construction Co., Canada Cement Bldg., Montreal, is engineer.